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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

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A Girdle Round the Earth

OCEAN flying is coming upon us with a rush. The Atlantic has not yet been flown in commercial conditions, and only trial flights have been made across the Pacific by the flying boat *China Clipper*, yet agreements have been made which provide for the regular commercial crossing of both oceans before another eighteen months have passed. This is all the more strange because only a few years ago there were many who believed that the so-called "cube law" put both oceans outside the sphere of all but stunt flights with an overload of petrol.

It stands to reason that if one ocean can be mastered so can the other. The only question is whether both offer sufficient commercial attractions. Wealthy traffic is always crossing the Atlantic, but can the Pacific be placed in the same class? Pan American Airways will get a mail contract from the United States Government for their service through Honolulu to Manila, and also for the southward branch as far as Pagopago, in American Samoa. From there down to New Zealand no pecuniary assistance from any Government will be forthcoming, and the air company will have to create its own traffic. The shortest and most convenient sea route between Great Britain and New Zealand is across the Pacific and through the Panama Canal. This means that New Zealand tourists and letter writers are quite familiar with the idea of making first for North America when the destination is the Old Country, and this familiarity is an asset on which the Pan American Company has doubtless relied. San Francisco is a good many miles north of the Canal, but, if one reckons by time and not by distance, it is nearer to Great Britain than is Panama. From San Francisco to New York there is an excellent air service, and from New York there will soon, we must believe, be an air service on to Ireland. A letter from New Zealand should be delivered in Great Britain in about a week.

On the other side of the world the boats of Imperial Airways, starting from England, will soon be making regular crossings of the Tasman Sea between Australia and New Zealand. Auckland, which Kipling once apostrophised as "Last, loneliest, loveliest, exquisite, apart," will then have become the junction (let no one dare to call it the Clapham Junction!) of two airways which, between them, will span the world. Thus the whirligig of aeronautics brings its revenges.

Mails or Passengers?

Despite the Panama complex of New Zealanders, the Pan American service to Auckland will have to depend on mails for its revenue for some time to come. That probably applies to all trans-oceanic services. There are certain basic facts which can be stated about air travellers. They are the people who can afford to travel first-class on trains and steamers, and they pay first-class fares for the sake of comfort, not for the sake of speed. The third-class passenger arrives at New York just as fast as does the first-class traveller. When the air companies invite such passengers to go by aeroplane they are offering them more speed and less comfort. It has been proved that these travellers want comfort and luxury, but it has not yet been proved that they, as a class, want more speed. The *Normandie* and the *Queen Mary* can, or will, offer very attractive speeds, and they also offer the greatest luxury. Nothing useful can be deduced from the occasional millionaire in a hurry. Will any large number of first-class passengers desert the *Normandie* and the *Queen Mary* for the comparatively cramped quarters of a flying boat?

On some routes the aeroplane offers attractions which may counterbalance the absence of swimming pools, ballrooms, gymnasia, and deck games. The Eastern

airway crosses land and sea alternately, and offers a rich variety of views. The aircraft on this route call at beautiful and interesting cities. The Atlantic flying boats will offer nothing but unmitigated views of the Atlantic, except when the aircraft are wrapped in fog and the pilot is flying by his instruments. The Pacific crossing from San Francisco to Auckland is to take three days. The sea may be more sunny, and there will be occasional coral atolls to watch, but three days of seascape are likely to prove an ordeal. Will the first-class passenger endure it?

For mails, however, the advantages will be enormous. Not long ago it took a fortnight for a letter from India to reach home, and New Zealand was infinitely farther away. To bring New Zealand nearer by half than India so recently was is a very mighty achievement.

Not Peace But a Sword

CHRISTMAS once more sees war in the world, a spectacle not witnessed since 1917. It sees all the old world in a state of great anxiety, yet holding fast to the hope that peace may soon be restored.

At this moment an aeronautical paper must pay a tribute of sympathy to Sir Samuel Hoare for the misfortune which has interrupted his public career. All who take an interest in aeronautics remember his two periods of office at the Air Ministry, and the more than sound work which he did there. But for him, commercial air transport would not stand where it stands now.

In his great speech of explanation in the House of Commons the late Foreign Secretary uttered some brave words which it did one good to read. Speaking of the position as it had been a fortnight previously, when oil sanctions were being considered, Sir Samuel said: "We had no fear as a nation whatever of any Italian threats. If the Italians attacked us we should retaliate, and, judging from our past history, we should retaliate with complete success."

Those words were doubtless addressed to Signor Mussolini, but they will find an echo in every British heart. At the same time, though victory may be a certainty, it is the duty of every Government to see that the sailors, soldiers, and airmen who have to do the fighting are so equipped that their victory will be won with the minimum of casualties. While there remains a possibility that, if oil sanctions are imposed, Italy will regard their imposition as a *casus belli*, the Government must be regretting that the repairing of our defences was not undertaken sooner. If our Navy and our Air Force had been brought up to date before we should face the present crisis with even greater confidence.

To Readers at Home, in the Empire and in Foreign Countries, the Editor and Staff of "Flight" extend Christmas Greetings and wishes for a Prosperous New Year, reciprocating the many kind messages received by air, land and sea.

The Outlook

A Running Commentary on Air Topics

A New Technique

JUST as soon as a decision has been reached in Britain a standardised method of "blind" approaches to aerodromes, it will be necessary to consider the training problems involved in the new technique. Obviously it will not be advisable to entrust passengers, or even machines, to pilots who have had no preliminary practice with any method used.

In Germany the training with the Lorenz system has been going ahead during the major part of 1935, and in America, too, quite a large number of pilots have been flying the Trimotor Ford and the Douglas, which have been used for tests with their country's own particular methods of blind or semi-blind approach. These methods, of course, still rely very largely on the pilot's skill in instrument and radio beacon flying, and the need for practice is probably much greater than in the case of the Lorenz system, which is largely automatic in operation. Nevertheless, as in the case of straightforward instrument flying training, the necessity for practice has a largely psychological basis. Pilots must, in fact, learn to rely implicitly on the visual and aural signals, and to check up on the previously adjusted sensitive altimeter.

Training Possibilities

IN last week's issue of *Flight* some details were given of the method which is being developed at Heston, though in this case the training would apply only to the "ZZ" system.

The instructor, from the front seat, fulfils the work of a control officer, and the international "Q" code is used for the passage of necessary information. Airwork and Mr. Davy are to be congratulated on their farsightedness, and, since the Lorenz system is to be used, experimentally at least, at Heston, the training methods will undoubtedly be expanded to include this system in due course.

The U.S. Department of Commerce, on the other hand, have interested themselves in an extremely ingenious ground trainer for use with the system sponsored by them. Although nothing can finally take the place of actual work under the hood and in the air, it would appear that a foundation of experience could be covered more cheaply and safely on the ground.

Those Tapered Wings

WITH the increasing popularity of the cantilever type of monoplane attention is being focused more and more on the aerodynamic qualities of the tapered wing. Its efficiency from the point of view of lift-drag ratio has been amply demonstrated, particularly since we have discovered the importance of fillets between wing root and fuselage. Hitherto, however, the lift distribution has not been given the attention it merits. Mr. P. Nazir was the first to publish information about results of wind tunnel tests (see *The Aircraft Engineer*, Monthly Technical Supplement to *Flight*, November 28, 1935) carried out by him at the Queen Mary College.

The wind tunnel staff of Handley Page, Ltd., has tested and experimented with tapered wings for a considerable time, and Dr. Lachmann has very kindly placed at the disposal of *Flight* some of the results of this work. The article is not of a highly technical nature, and is pleasantly devoid of "performing equations," so that the explanations given and the arguments put forward can be followed by those who have not made a special study of aerodynamic theory. At the same time, Dr. Lachmann's exposition of the subject will be found of value to the designer, technician and student of aerodynamics. In view of its wide general interest it has been decided to publish Dr. Lachmann's article in *Flight* next week rather than to retain it for publication in *The Aircraft Engineer* at the end of January.

One sometimes hears the argument put forward that the tendency of the tapered wing to stall first at the tips can be cured by giving the wings a "wash-out," that is to say, by decreasing the angle of incidence towards the wing tips. This solution seems obvious and simple. Dr. Lachmann points out, however, that the angle of twist which even a very moderately tapered wing must be given is excessive—something in the neighbourhood of fifteen degrees. Obviously this would mean, in a modern fast aircraft, that at high speed the wing tips would be at a very small incidence, or even at no lift or negative lift. Dr. Lachmann suggests a remedy. What that is may, perhaps, be guessed!

"A Great Deal of Nonsense"

THE House of Commons has been enlivened by the return at the general election of the very popular former Under Secretary for Air, Mr. Montague. Quite recently there was a debate on the possibilities of an international air force, in the course of which several speakers touched on the possibility of converting civil aeroplanes into bombers.

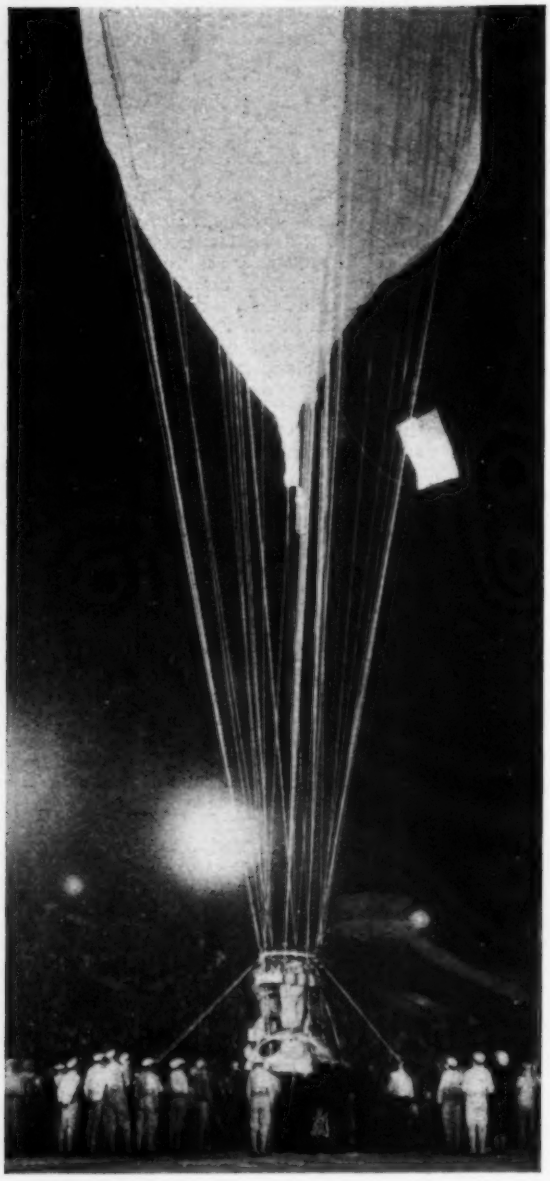
Mr. Montague, naturally, is knowledgeable on that subject and pronounced that "a great deal of nonsense is spoken about that possibility." He admitted that if all military aircraft were abolished, it might be possible to fight with civil aircraft. Some people, he said, had the idea that some day the sky would be darkened by a great fleet of commercial aeroplanes coming over to drop their bombs out of their cabin windows. He went on to delight the House by picturing some future Wellington or Blücher exclaiming:—

> "The Pterodactyl and the Busy Bee,
> The Gyro and the Flying Flea,
> They may not fright the enemy,
> But, by God, they frighten me."

Life in the Old Dog

THE modern tendency in the design of large commercial aeroplanes is toward two- and four-engined monoplanes. There are, however, some thoroughly modern machines with three engines—built to a formula which, according to many "in the know," is virtually dead. Air France alone has three large triple-engined monoplanes on test. Two of these are Dewoitines—a long-range eight-seater and a thirty-passenger model, the third being the Marcel Bloch *Pacifique* which seats thirty. Each of the two last machines, particularly the Bloch, has a fuselage so huge in cross-section as to make the big Mistral Major in the nose look quite insignificant. Yet both are said to be faster than the Douglas D.C.2.

Italy, too, is showing pronounced interest in the three-engined monoplane; her fastest transport and bomber, in fact, are both of this layout. The American Stinson machine recently produced expressly for feeder-line operation is another example. There seems, in fact, to be quite a useful life ahead for the three-engine aeroplane—which only goes to show how few subjects there are upon which we all think alike.



Stratosphere balloon ascents are not always uneventful. This is the start from Chicago on August 5, 1933—watched by 10,000 people—of a balloon piloted by Comdr. T. W. G. Settle, U.S.N. Owing to a valve sticking open, it descended into a Chicago stock-yard after rising only 5,000 ft. The pilot was unhurt.

STRATOSPHERE EX

A Review of the Notable Ascents of Re
"Explorer II" Experiment : A St Cosm

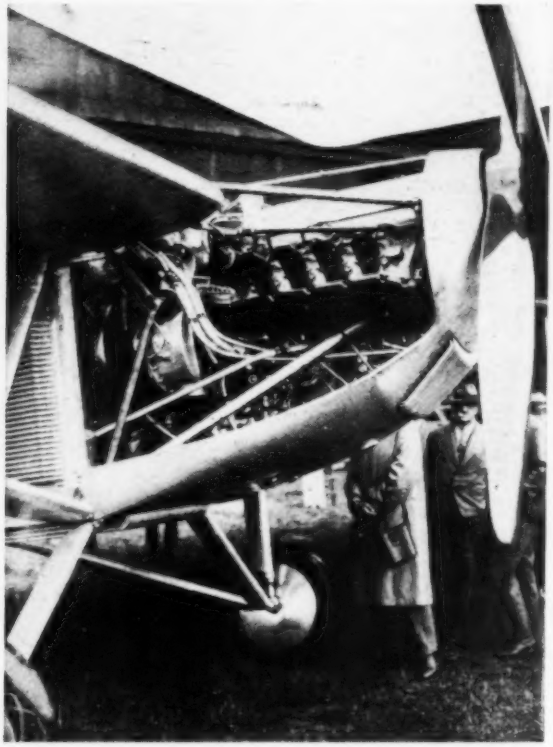
In "Flight" of December 12 there appeared a résumé of a paper read at Socie of stratosphere travel and discussing atmospheric conditions at great h article various exploratory flights and describing some of the inte ay expe

BALLOONS may be "useless," but they can gain height records that are denied to aeroplanes. A heavier-than-air machine has reached nine miles, but a balloon has gone five miles higher—and that, in the stratosphere, is a tremendous achievement.

The reason is simple. As *Flight* readers know, an aeroplane reaches its ceiling when, notwithstanding the help its engine has received from a supercharger in counteracting the excessively "thin" atmosphere, it cannot climb any more. The balloon can go a great deal higher before its progress ceases. It rises until its gas becomes equal in weight to the air that is displaced. The vessel may be carried above that height by momentum, but when it loses that it drops again to its equilibrium height.

Balloons of enormously increased capacity have led to the spectacular successes—and failures—in recent years which culminated in last month's great American exploit. *Explorer II*, as it was called, has been compared with a building of thirty-one storeys, for it towered to a height of more than 300ft. Its gas capacity was 3,700,000 cu. ft. —although, of course, nothing like that volume was pumped into it. Only 230,000 cu. ft. of helium was put in, for allowance had to be made for expansion to more than ten times that amount.

The advance made by the Americans may be appreciated by remembering that this balloon has a gas capacity six and a half times greater than that used by Professor Piccard in his stratosphere flight of May, 1932. Professor



The inverted twelve-cylinder water-cooled Farman engine of the Farman stratosphere monoplane. Part of the two-stage supercharger can be seen. The machine, which had a sealed and "supercharged" cabin, was described in detail in *Flight* of September 12. Unfortunately, before any decisive results were obtained, the Farman crashed while making a demonstration flight; apparently the pilot, M. Cogno, died during the flight, after attaining a height of 34,000 ft.

EXPLORATION

Scientific Objects of the Cosmic Rays.

By GEORGE FYFE

Society of Arts by Prof. G. T. R. Hill, setting forth the possibilities article Mr. George Fyfe deals with other aspects, briefly reviewing y experiments carried out during the latest American ascent.

Piccard, however, is entitled to a great deal of the credit for subsequent triumphs by other people, for he was the first to demonstrate in a practical way the feasibility of substituting for an open basket a globe-shaped, hermetically sealed metal cabin.

It seems inevitable that any further attempt by aeroplane will be made with the aid of a sealed cabin. All the indications are that it is essential. When Comdr. Donati returned from his heavier-than-air record flight to 47,352 ft. in a Pegasus-engined Caproni in 1934 he was exhausted, and Capt. C. F. Uwins, on his previous record ascent to 44,000 ft. (in the Pegasus Vickers Vespa), returned to earth with the conviction that beyond this height it would be impossible for a man in a more or less open cockpit to absorb his special oxygen supply—which must be adminstered under pressure if it is to be effectively transmitted to the blood stream.

Capt. C. F. Uwins, who attained a height of 43,976 ft. in the Vickers Vespa (special supercharged Bristol Pegasus) in 1932, wearing the oxygen equipment which he employed (*Flight* photograph).

One is safe in assuming that attempts to reach the stratosphere, and stay in it as long as possible, will be numerous in the next few years. So far we have touched merely the fringe of the problem. Professor Piccard said some time ago he would go up again if provided with the necessary funds, while the Russians are extraordinarily keen on adding to their knowledge of the upper atmosphere.

Professor Prokofieff, who has been up to 11.8 miles, firmly believes that the stratosphere will be conquered before long, and he regards it as vital that Russia should be the first to learn its secrets. "Nobody then," he says, "will be able to make a stratosphere raid on us." This declaration has been applauded in his country, where it seems to be taken for granted that it is only a question of time before the stratosphere will be

The latest stratosphere balloon sponsored by the National Geographic Society of America, the *Explorer II*. The occupants were Capt. Albert Stevens and Capt. Orvil Anderson, of the U.S. Army Air Corps. The balloon is seen descending near White Lake, South Dakota, after reaching the record height of 74,000 ft. Note the dust from the many cars "chasing" it.

extremely important from the military point of view.

Other nations, however, want to probe the secrets of the upper atmosphere for a variety of reasons. While they are attracted by the supposed opportunities for military and commercial machines in a limitless area where colossal speeds may be attained in an atmosphere free from cloud and fog, their speculations embrace something very much more important. They are actually concerned with secrets of space that are thought to have a direct bearing on the source of life itself.

Consider the fascinating position to which scientists have brought us.

At the beginning of this century, Lord Rutherford and others applied themselves to the investigation of certain mysterious rays that have great penetrating power. Their work, followed up by others, led to the belief that these rays did not originate on earth, but high above it. Laborious experiments by Professor Milliken left no room for doubt that they were of cosmic origin, and he eventually formulated the theory that these rays resulted from the creation of atoms out of the electrons and protons in interstellar space.

He has argued that they demonstrate a continuous pro-

Explorer I. was not so lucky as its successor. This remarkable photograph shows the fabric tearing and collapsing on to the gondola during the last 7,000 ft. of its descent into a Nebraska cornfield.

cess of creation; that the cosmic ray may be likened to the birth-cry of an atom. There are other scientists who believe, however, that the cosmic ray does not register the act of creation at all, but the very reverse—the annihilation of space. The cosmic ray, they say in effect, is not the atom's birth-cry, but its death-wail.

It is obvious that the best place in which to obtain more exact information than we at present possess is in the stratosphere. The Americans who went there by balloon last month regarded the investigation of cosmic rays as their most important of many tasks, and for this purpose they took apparatus in the form of Geiger counters. It was shown that at an altitude of fourteen miles cosmic rays had an intensity 150 times greater than on earth.

A Curious Experiment

Incidentally, attempts were made to ascertain what effects could be traced to the action of the rays. One experiment was curious. Research workers at Wisconsin University have evolved the theory that young fruit flies have their sex influenced by certain kinds of rays, and to test this theory a number of these flies (which have so short a life cycle that new generations occur within a period of a few hours) were taken up to the stratosphere in order to see what would happen to them when exposed to cosmic rays at their greatest strength.

Many other duties were carried out. Several vacuum casks were opened in the stratosphere for the purpose of obtaining air samples. Living spores of bread and strawberry mould were carried up to see what effects resulted from exposure to the upper atmosphere. A sterile tube containing a sticky substance was also dropped, by parachute, to see what living organisms could be picked up on the way down.

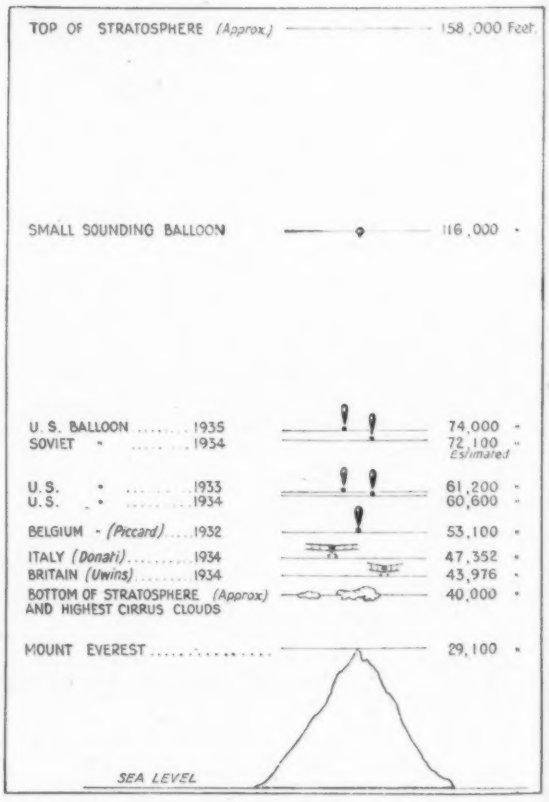
No fewer than eighteen cameras were carried in the gondola, the function of sixteen of them being to register automatically, through the medium of watch-faces, the times at which various records were taken in regard to many observations.

Temperature changes were continuously recorded; an elaborate scheme was carried out to check the accepted method of measuring altitude; spectographs were relied upon for the obtaining of data concerning the ozone layer; radio phenomena were studied by means of two small sets transmitting on very short wavelengths; greatly increased electrical conductivity received attention by reason of its possible effects on ignition systems at high altitudes; wind velocity and direction at these great altitudes were not forgotten.

Radio Conversations

And Capt. Stevens, who acted as scientific observer, was able not only to look after all the instruments that had been closely packed in the gondola, but to take photographs showing the earth's curvature, and to hold radio conversations at very frequent intervals on the eight hours' flight with people who were in various parts of the United States, with the occupants of the China Clipper as it sped across the Pacific and with a representative of the *Daily Telegraph* who spoke from London.

No trip to the stratosphere could have been organised more elaborately, and scientists all over the world are waiting with some eagerness for the examination of results achieved in a region where the upper part of the sky was of such a deep blue as to seem almost black.



Visual comparison: This diagram, to scale except in the case of the actual objects depicted, tells at a glance the story of stratosphere exploration to date.

THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

Royal Tournament, 1936

The Royal Tournament for 1936 will be held at Olympia, London, from Thursday, May 7, until Saturday, May 23, inclusive.

The Prince and a War Book

General Goering's adjutant, Lt. Comm. Bodenschatz, a survivor of the Richthofen squadron, has received a message of thanks from the Prince of Wales for his book *Chase in Flanders Skies*. The author of the book pays tribute to the bravery of British airmen.

"Canons" for Caudron

A military version of the high-speed twin-engine Caudron monoplane, which bears such a striking resemblance to the D.H. Comet, and which is now being tested, mounts two *canons*, a machine gun in the rear cockpit, and racks for light bombs.

The Mew Gull Timed

Just to prove what the machine really will do Captain Percival has put his Gipsy-Six-engined Mew Gull six times over a thirteen-mile course. The average speed was 225¾ m.p.h. At the moment the "Mew" is on the Continent in charge of Mr. Percival's French representative.

Going Places

Envious, no doubt, of the assorted aeroplanes departing day in, day out, for distant lands, the 6ft. "met." balloon at Croydon, bearing its full complement of instruments (aneroid, thermometer and hygrometer) cut loose last Tuesday and headed for parts unknown.

BROADSIDE OVER EAST SIDE. As might be deduced from the nature of the machine on which it is mounted, this is not one of the new large-bore *canons* which are being prepared for long range aerial engagements, but a Fairchild camera, specially developed for photographing New York and other cities whose skyscrapers defeat more normal photographic apparatus.

On the Air

"Conquest of the Air" is the title of a series of talks to be broadcast by the B.B.C. on Saturdays of the new year. Civil aviation, aerial warfare and the gas peril will be discussed, and speakers have received instructions to review these subjects "with balance and restraint," but not to shirk controversial issues.

In Business Next Year

Sir Alan Cobham's air circus has been disbanded, but all the equipment has been acquired by C. W. A. Scott's Flying Display, Ltd., which has recently been formed. The chairman of the new company will be Mr. C. W. A. Scott, the managing director Capt. P. Phillips, and the other directors Mr. T. A. Pawlyn and Mr. John Leggitt. Mr. D. L. Eskell will be general manager.

A Million for a Gyroplane

By covering a closed circuit of half a kilometre, at an average altitude of about 100 ft., the Breguet gyroplane described in *Flight* last week has won for the builders a prize of one million francs. For certain other specified performances further prizes are offered by the French Air Ministry, to a total value of more than three million francs.

UNINTELLIGENT ANTICIPATION? The caption to this photograph, as supplied by a picture agency, reads: "Field hospitals have been established by the Italian Army on the northern front to render aid to wounded Abyssinian soldiers. The doctors have to do much of their work under the rays of the fierce sun, wearing pith helmets with their white surgical robes. This photo shows an Abyssinian having a leg injury bandaged by doctors at a field hospital."

Twenty-five Years Ago

(From "Flight" of December 24, 1910.)

"Experiments have been carried out recently at Johannisthal with small captive balloons carrying lights, and intended for marking routes for aerial navigation. The balloons tested were of various sizes, ranging from 3½ft. in diameter to 8ft., and the lamps they carried were lighted by electricity supplied by a wire communicating with the earth. The lights were visible for a distance of six miles."

Private Flying

Topics of the Day

Weather or Not

IT is probably fortunate that the vast majority of people "die many times before their death." Otherwise a large proportion of the population might treat pedestrian crossings as they treat pavements, and a still larger proportion of pilots might take off in conditions of no visibility with an unreasonable confidence in the reliability of their engines and of the meteorological people's forecasts.

The question, however, which worries the not-too-experienced amateur is not "Shall I take off?" but "Shall I go on, land, or turn back?" when things start to happen to a previously clear or fairly clear atmosphere. It is obviously quite foolish to set off when the far boundary of the home aerodrome is blotted out unless telephone calls, made immediately before leaving, indicate that one's destination and at least one nearer aerodrome have an improving visibility of at least a mile.

As the internal air route system becomes more involved and more important, a great many airports will, in any case, have their "controlled zone" systems. The pilot flying without radio in poor conditions will then need to fly over a nearby aerodrome, outside the zone, in order to see whether the Q.B.I. ground panel is laid out or not. In fact, the private pilot of the future will probably have a rather thin time. Commercial flying must come before private and club flying.

The Better Part

NO advice about this question of deteriorating visibility can possibly be of any real value. Since experience of impossible conditions can only be obtained at serious risk to one's neck, it is advisable always to make discretion the better part of valour, and to land or turn back while the going is good.

Some two years ago I was flying a staggered Cadet from Woodford to Blackpool. Everything was set and fair, and I had obtained an encouraging check on my compass course when I suddenly realised that visible world was diminishing quite rapidly. An easterly breeze was blowing all Manchester's smoke along the Ship Canal, and this smoke was reaching a height of 2,000ft.

I felt fairly certain that Blackpool would be clear, but I was equally certain that conditions would be bad until the Ribble had been reached, and that they would be even worse when returning, towards dusk.

The Ship Canal could be discerned below as a dull, silver ribbon, and disappeared again almost immediately; Barton Moss might have been anything; and Wigan's railway system is too complicated to be followed even in the best of weather. I turned back, knowing that the little fields of Cheshire, each with a little pond, were in clear weather, and rumbled over the boundary fence at Woodford with the certain conviction that Blackpool would still be in the same place on the following day.

A Cure for Worry

NOT so long ago I had a much more interesting experience in very thick weather, though on this occasion the machine had two engines and was being flown by a pilot of very considerable experience. Nevertheless, the fact that we *were* lost for a while, and that my maps were the only ones aboard the machine, suggested that the more experienced pilot may sometimes lead himself into situations in which the more cautious novice would never find himself. The novice might never leave the ground in such conditions, and, if he did, he would either keep the home aerodrome permanently in sight or would work out the most elaborate compass course, checking up against every stretch of water or length of railway line vaguely discernible immediately below.

The whole point was that within a period of half an hour the general visibility became a hundred per cent. worse, and another half-hour might possibly have blotted out aerodromes which were still clear. All the engines in the world would not have saved us, though the confidence given by a pair of engines and by an endurance of three or four hours was very considerable.

If I was a private owner with a handsome account I should most certainly have a twin-engined machine with two-way radio, and I should take both R/T and W/T tickets. Then, at least, I should be able to use controlled aerodromes in Q.B.I. conditions, and would make much better use of my machine. As a worried man of "big business," I should be forced to forget it while obtaining D/F bearings, and while waiting for a landing turn at Croydon! That would do a world of good to a man with his head full of market quotations.

Expect the Worst

WHEN the fate of Imperial Airways' Short *Syrinx* at Brussels is remembered, it is not difficult to realise that the weather can play some very rude tricks on the unsuspecting aeronaut.

Last week a friend of mine, who does a good deal of flying in a quiet Sunday way, flew some eighty miles to lunch at a West of England aerodrome. When he landed the wind was blowing at about 10 m.p.h., and after lunch the aerodrome manager told him that the weather reports were bad—squalls in the offing—and that if he wanted to get back he should start at once.

It was already raining, but the machine was sheltered from the wind while being run up. However, when he had taxied down wind he turned, and immediately a wing almost touched the ground. If he had not been completely misled about the wind strength by the fact that the aeroplane was partially sheltered during the running-up process he would have obtained the services of a G.E. at the wing tip. Morals: Always expect the worst and never judge the wind speed while standing on the tarmac.

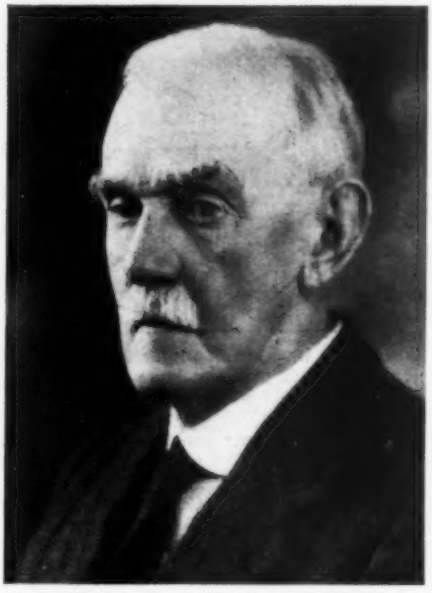
INDICATOR.

SIR RICHARD GLAZEBROOK

A Tribute by Mr. H. E. Wimperis, C.B.E., M.A., F.R.Ae.S., M.I.E.E., Director of Scientific Research, Air Ministry

THE sudden death last Sunday of Sir Richard Tetley Glazebrook removes one of the senior members of the aeronautical world—a man revered by all as one who gave himself freely for nearly one-half of his active life to this field of work, and who made for himself a place which will never be forgotten.

His link with the science of aeronautics became a possibility when he accepted the difficult task of guiding the infant National Physical Laboratory at Teddington. That began in 1899. Within ten years there was created, by Lord Haldane, the Advisory Committee for Aeronautics, which, with some alteration in title and none in duties, remains in full activity today. Of that Committee Sir Richard became chairman, under the presidency of the late Lord Rayleigh. Wind tunnels sprang up with rapidity in the hospitable soil of Teddington. Bushy House began that career of scientific hospitality for which it is, and remains, justly famous.



Sir Richard Tetley Glazebrook, F.R.S.

The youth of the National Physical Laboratory was spent in years during which the controlling hand of the State on its novel infant, scientific research, needed to be closely watched, and Sir Richard was an ever-watchful guardian. One of the safeguards devised for the infant laboratory was its control in matters scientific by the Council of the Royal Society, and this control has continued to this day—despite, in the important Aerodynamics Division, the foster-parentage of the Air Ministry, which, having other aeronautical research establishments elsewhere, might have been forgiven if it had thought some kind of unification in control an obvious goal.

It speaks much for Sir Richard that he was able to steer the affairs of the Laboratory through such complicated waters. He was a most constant attendant at the meetings of the various research committees, and saw to it that the written record of their work was made as complete as previous academic experience had taught him it could be.

At a complimentary dinner given in his honour at the Athenæum, when he had completed twenty-one years of service as chairman of the Research Committee, he gave a moving account of his early hopes and early efforts in the very beginning of the aeronautical work at Teddington. That work he continued until two years ago when, in fullness of years, he retired from the Research Committee and its labours. He received many honours, among them the Gold Medal of the Royal Aeronautical Society, the Zaharoff Chair at the Imperial College of Science, the K.C.B. from His Majesty in 1920, and the K.C.V.O. only last year.

It is a tribute to his immense energy that Sir Richard Glazebrook, while carrying out the important duties with which the State entrusted him, yet found time to undertake simultaneously many other duties, both official and non-official.

He was in every sense a great public official, and the aeronautical world is deeply in his debt.

The Late Prof. J. D. Cormack

THE death of Prof. John Dewar Cormack, C.M.G., C.B.E., D.Sc., which took place recently, will be widely mourned, but surely (writes a correspondent) none will regret it more than those who served with him during the dark days of the War. In 1915 "Col." Cormack was chief contract officer at Adastral House in Albemarle Street, and later, at the Hotel Cecil and at Blackfriars (de Keysers' Hotel), Assistant Controller of Aeronautical Supplies. These positions, of course, meant a tremendous strain of work, but Dr. Cormack never let his staff feel that strain.

An Eagle on Business

MR. R. VAUGHAN-FOWLER has recently left England in a demonstration B.A. Eagle for India on a business aerial tour. He expects to be away approximately three months and will visit, among other places, Cairo, Baghdad, Karachi, Bombay, Calcutta and Madras.

Ahead of Schedule

DURING the present hectic period of expansion there are probably few aircraft firms which can claim to be ahead of their delivery programmes. That Handley Page, Ltd., is in that fortunate position was disclosed by Mr. F. Handley Page at the firm's annual staff dinner last Friday, and in this connection he paid a well-earned tribute to the production department and to Mr. Hamilton, the firm's works manager. Mr. Handley Page pointed out that while the production department had done well, it was necessary that all should realise that the technical department had a difficult job in getting out new designs, and that the drawing office did not exist merely to produce modifications, as some were apt to think.

Mr. Handley Page and Mr. Worley, the chairman of the company, both stressed the importance of everyone realising that they were working for the safety of the nation, and dwelt on the necessity for good teamwork and for maintaining quality as well as quantity. Mr. "Jack" Jarvis, of the A.I.D., was welcomed back in the fold after an absence at headquarters.

Our Telephone Number

AS from January 1 the telephone number of *Flight* (Dorset House, Stamford Street, London, S.E.1) will be changed from Hop 3333 to Waterloo 3333.

Still Trying to Break the Pegasus Spirit

FOLLOWING upon the recent publication of the fact that the Bristol Pegasus III engine had completed an overload test of 300 hours, it is now announced that another overload test of 370 hours has been carried out at a continuous output of 800 b.h.p. at 2,300 r.p.m. This compares with the normal output for the Pegasus III engine of 665/690 b.h.p. at 2,200 r.p.m. at 3,500 feet (1,075 metres), with a maximum permissible output (for not more than five minutes) of 750/775 b.h.p. at 2,575 r.p.m.

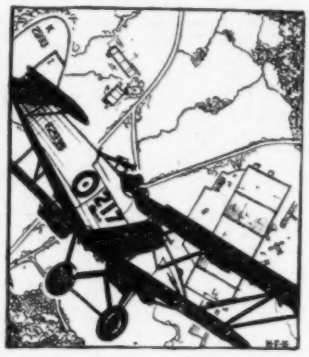
Despite the fact that the engine was maintained continuously for such a lengthy period at a power considerably above its maximum rating, the only cooling was that provided by a Fairey metal airscrew weighing 196 lb. (88.9 kg.).

THE FLEDGLING

Some Further Thoughts on the Lighter Side of Service Life

By Ex-Pilot-Officer F. W. RICHARDS

EVERYEODY who joins the R.A.F. expects to be immediately ushered into an aircraft and borne aloft. This is an entirely erroneous idea; in point of fact, and judging by my own experience, the tyro spends his first two or three weeks writing his name on officially dotted lines, until it becomes his fixed opinion that the chief duty of an officer is not flying aircraft, but signing signatures.



As a result of all this signing, my impatience grew almost to the point of mutiny, until, in my second week at No. 2 F.T.S. it was assuaged by the sight of a senior pupil making a spectacular if somewhat original landing. At twenty feet his aircraft stalled, and, dropping like a stone, bounced a further ten feet, finally coming to rest on the tarmac minus its undercarriage. The pilot blandly explained to any who cared to listen that he had "hit a pocket." To my inexperienced ears the excuse sounded adequate but alarming.

So much has already been written on the subject of first flights that all I propose to say of mine is that I experienced acute amazement and foreboding when I observed the apparent frailty of the wings, and thought about the weight they were supporting.

First solo flights have also received quite enough attention from better pens than mine, and, in any case, all I remember of mine is that, with painful memories of some of my Flight Commander's choicest phrases ringing in my ears, and feeling acutely conscious that the front cockpit was empty, I picked up the speaking tube and directed a long and complicated flow of rhetoric at the absent instructor.

The first entry of interest in my log book is, "Twenty minutes forced landing practice; reported from Waddington." Thereby hangs a tale. I had just learned how to slow-roll and loop, and, not realising how unlike orthodox aerobatics my efforts were, I was very proud of them, and very irate at being told to practice forced landings for a whole twenty minutes. I therefore repaired unwillingly to Waddington (which is the home of a Special Reserve Squadron) and started to practice my landings; but after five minutes I grew bored, and, thinking the aerodrome untenanted during week-days, proceeded to vary the monotony of into-wind landings with a few down-wind, I then did some of my extremely peculiar aerobatics at a low altitude, and rounded off the perfomance by returning to Digby and landing on one of my wing tips.

Five minutes later I learned from a particularly adjectival speech that my Flight Commander had listened to a running commentary on my performance given by the Waddington Adjutant over the 'phone. The next day, as a punishment, I cleaned my machine instead of flying it.

The next entry of interest is, "Forty minutes forced landing practice; alighted on wrong side of hedge, spoilt both hedge and undercarriage, farmer furious." This needs no explanation.

Another self-contained entry is, "Three minutes' low flying. Tree got in way. Broke aircraft, bruised shin."

Before leaving the F.T.S. there is the story of the pupil at Grantham, who, when flying solo, observed a slight mist, and an aeroplane on its back on the aerodrome; so, feeling that a few hours' leave would do him no harm, he used the mist as an excuse for a "forced" landing, and set off in search of a large field in proximity to a cosy pub. But pubs, cosy or otherwise, do not abound in Lincolnshire, and it was a long time before he found what he wanted. As there were two trees in the centre of the field he flew round it a second time to make a final inspection. At this point his fuel gave out, and, in his haste to land, he came in between the two trees. Unfortunately, the span of the aeroplane was greater than the distance between the two trees; and a short time later the following conversation took place on the telephone between the pupil and his instructor:—

"I've forced landed and bent a wheel, Sir."

"If that's all it won't take five minutes to change it."

"The axle is not quite the same shape as it was, Sir."

"Is that all?"

"No, a wing is bent, Sir."

"Anything else?"

"The other wing is bent, Sir."

"Is anything not *broken*?"

"Well, er—to the naked eye, Sir, no, Sir."

On my first flight at a squadron I was sent up to do R/T., and by a miracle (for I usually failed to hear anything at all) I picked up a conversation between two other machines and heard this:—

"Hullo, Red one, Red three calling. Do you know you are leading the flight over a prohibited area at 300 feet?"

"Of course I do, but that is no reason why you should give public broadcasts on the subject."

Two other little memories come to mind.

In the "Line Book" of No. 25 Squadron reposes a letter from a dear old lady, asking the price of a week-end return flight to Paris.

After my first attempt at diving bombing, I was climbing out of my machine when I was met by my Squadron Commander, who said in a tone that can only be described as "sweet": "*Very nice*, but you should remember that only the bomb is intended to hit the ground."

Forthcoming Events

Club Secretaries and others are invited to send particulars of important fixtures for inclusion in the list.

Jan. 14. Irish Aero Club. Annual Dance, Gresham Hotel, Dublin.

Jan. 16. R.Ae.S. (Coventry Section) Lecture: "Development in Centrifugally Cast Piston Rings for Modern Aero Engines," by Mr. P. R. Twigger, 8 p.m., Armstrong Siddeley Canteen.

Jan. 22. Royal United Service Institution Lecture: "The Expansion of the Royal Air Force," by Air Marshal Sir C. L. N. Newall, at 3 p.m.

Jan. 22. Civil Aviation Service Corps, No. 1 (London) Sqn. Dance, the Horns, Kennington, 8.30 p.m.

Jan. 30 and 31. Aerodrome Owners' Association: Annual Conference and Aerodrome Equipment Exhibition, British Industries House, Marble Arch, London.

Feb. 12. Yorkshire Aviation Services Country Club. Dinner and Dance, 8 p.m., Grand Hotel, Harrogate.

Feb. 20. R.Ae.S. (Coventry Section) Lecture: "Variable-pitch Propellers," by Mr. T. E. Beacham, 8 p.m. Armstrong Siddeley Canteen.

Feb. 28. Bristol and Wessex Aeroplane Club: Annual Aviation Ball.

Mar. 10. Royal United Service Institution Lecture: "The Development of Civil Aviation," by Lt. Col. F. C. Shelmerdine, at 3 p.m.

Mar. 19. R.Ae.S. (Coventry Section) Lecture: "Type-Testing an Aircraft," by Flt. Lt. Bulman, 8 p.m., Armstrong Siddeley Canteen.

December 26, 1935 Supplement to FLIGHT 670a

The AIRCRAFT ENGINEER

"FLIGHT" ENGINEERING SECTION

Edited by C. M. POULSEN

No. 119 (Volume XI No. 6) 10th Year December 26, 1935

FATIGUE TESTING

An Outline of the Routine Laboratory Tests of Bristol Engines

FAILURE of aero engine components may be due to a number of causes; in a few instances the actual reason for failure may be very obscure, but in the majority of cases it may be fairly accurately attributed either to imperfect material or over-stressing, or a combination of both.

The large majority of failures are, moreover, of a well-defined type and characteristic of a set of conditions in which the stresses imposed are of a fluctuating nature. The most simple form of fluctuating stress is that in which the stress changes from tension through zero to compression, the maximum stress in each direction being equal. This is known as a reversed stress. In some cases the stress may fluctuate from zero to a tension stress, this type being known as a repeated stress.

A third type includes those cases where the stress is never zero, but fluctuates over a range of values above the zero line. This is known as a pulsating stress. In all the above cases one complete reversal of stress is known as a stress cycle. Fig. 1 shows in diagrammatic form the various forms of stress cycles described above. In addition to the simple tension and compressive stress fluctuations more complex stress cycles may occur, such as reversed torsion, reversed bending and combinations of both.

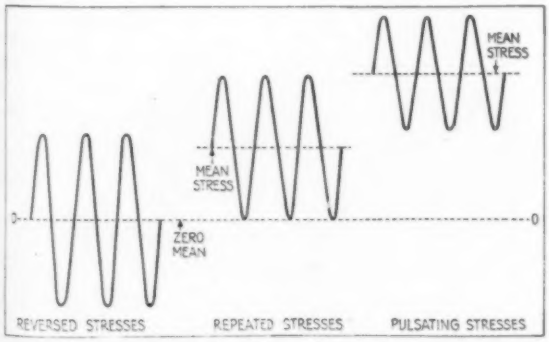


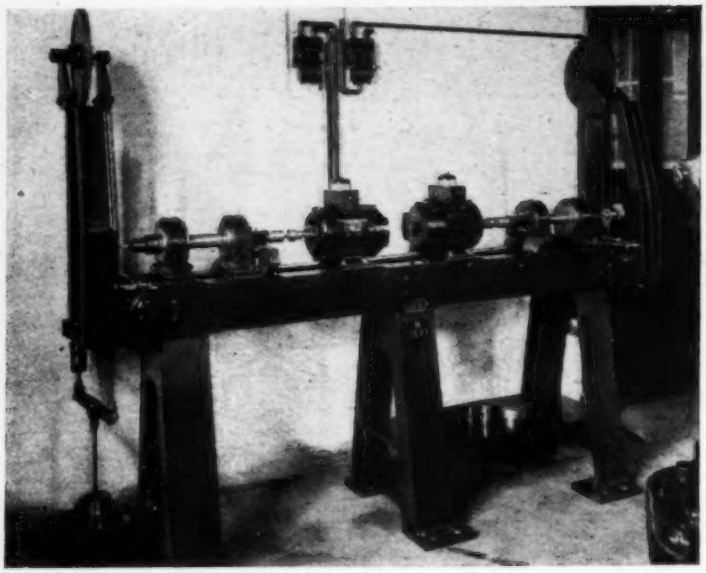
Fig. 1: Various forms of stress cycles.

The type of failure produced by these cycles of stress is known as a fatigue failure, and the actual propagation of the crack through the component may be either extremely slow or fairly rapid, depending upon the degree of over-stress and the material concerned. The crack itself has certain well-defined characteristics and it is usually possible to deduce the initial nucleus of the crack and the speed of propagation from its appearance. A photograph of a typical fatigue crack is shown in Fig. 2.

Fatigue cracks invariably originate at some point of stress concentration in the component; e.g., screw threads, oil holes, sharp radii and similar localities, and it is necessary for the designer so to proportion the component in question as to eliminate these stress-concentrating factors as much as possible. In this respect it might be mentioned that in regard to this point of stress concentration some materials are much more sensitive than others to sharp corners and abrupt changes of section. This property is sometimes known as "notch-sensitiveness."

When an aero engine is designed, the materials of which it is constructed are carefully selected for certain specific purposes. Some components require high strength and resistance to fatigue characteristics; in others good bearing properties are essential, while others again may require to possess good heat conductivity, high thermal expansion and similar features.

It is desirable, where possible, to be able to test the various properties of materials without recourse to long and expensive main engine tests, and it is here that the metallurgical laboratory is able to render such valuable assistance to the complex process of evolving and producing aero engines. Among the various properties and materials investigated by the laboratory, the resistance to fatigue is one of the most important. A great deal of knowledge and practical data that are of the utmost value to the designer may be obtained from the fatigue testing of model sections; the designer can evaluate the stresses involved more accurately and, in addition, considerable expense is saved in avoiding costly main engine experiments. It also forms a very convenient method for quickly obtaining exact information on new and untried material, and can be used to assess the increased strength characteristics of improvements in detail design.



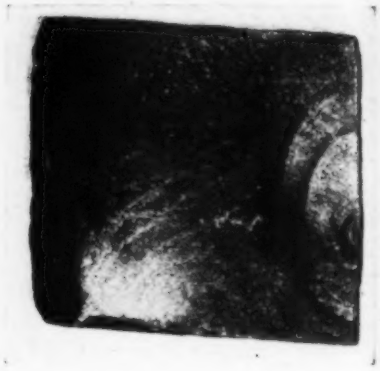
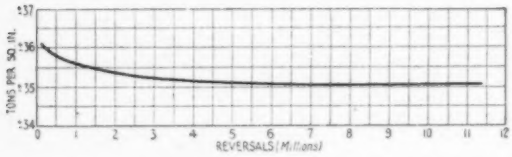


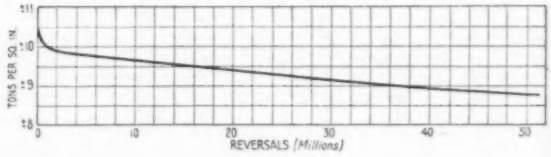
Fig. 2 (above) : A typical fatigue crack. In Fig. 3 (left) is shown a Wöhler fatigue testing machine used in the Bristol engine laboratory.

The laboratory of the Bristol Aeroplane Co., Ltd., at Filton, is well equipped with up-to-date apparatus to perform a variety of fatigue tests, and includes the following machines :

Wöhler Fatigue Testing Machine. This machine is illustrated in Fig. 3. The test piece acts as a rotating cantilever, the stress varying from tension to compression by a single electric motor at a speed of 2,120 r.p.m

Amsler Repeated Impact Machine. The machine shown in Fig. 7 is the Amsler repeated impact testing machine with which it is possible to obtain impact fatigue data employing tensile, compression or transverse stresses. The machine is operated by a single electric motor and, on account of the staccato and somewhat unpleasant noise





Left, Fig. 4 : Stress endurance curve of nickel-chromium molybdenum steel, oil hardened and tempered. Limit of proportionality, 43 tons per sq. in. ; 0.2 per cent. proof stress, 56.4 tons per sq. in. ; max. stress, 62.2 tons per sq. in. ; elongation, 24.8 per cent. ; R. of A., 65.0 per cent. Right, Fig. 5 : Stress endurance curve of wrought magnesium alloy. Limit of proportionality, 4.0 tons per sq. in. ; 0.1 per cent. proof stress, 12.0 tons per sq. in. ; max. stress, 20.2 tons per sq. in. ; elongation, 19.7 per cent. ; R. of A., 32.0 per cent.

every reversal. This machine is of the uniform bending type, a characteristic obtained by specially applied loading, whereby the stress is uniform in the test piece over a length of 1½ inches, instead of concentrated at one point as happens in a singly loaded machine of this type. Uniform loading is particularly useful for testing screw threads and similar components over which the normal stress is evenly distributed. Four of these machines are at present installed in the laboratory ; they are driven independently by small electric motors at either approximately 2,000 or 3,000 r.m.p. Figs. 4 and 5 show stress endurance curves obtained from tests made on this type of machine. The curves represent :

(1) A nickel-chromium molybdenum steel heat-treated to give 62.2 tons/sq. in. maximum tensile strength.

(2) A wrought magnesium alloy having a maximum tensile strength of 20.2 tons/sq. in.

Combined Stress-Fatigue Machine. The machine shown in Fig. 6 is the special combined stress-fatigue testing machine designed by the National Physical Laboratory. This actual machine is the first of this type to be installed in an aero engine laboratory. The test piece does not rotate, and it is possible with this machine to obtain reversed bending stresses, reversed torsional stresses or any combination of the two, by varying the relative angle at which the test piece is held. The machine is actuated it emits when in operation, it is housed in a sound-proof cabinet which incorporates a quickly removable section for inspection purposes.

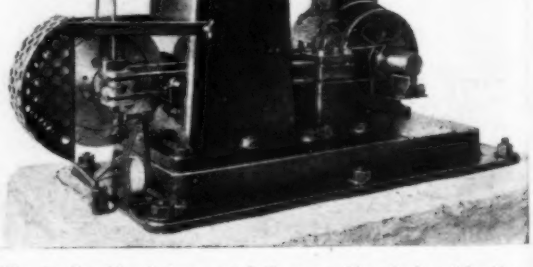


Fig. 6 : Combined stress and fatigue machine designed by the National Physical Laboratory.

Crack Detection

Although described previously (*Flight*, March 7, 1935), mention may also be made of the " Magna-Flux " method of fault detection, which is used extensively in the Bristol engine laboratories. The apparatus incorporates a large coil, energised by direct current, a solid core, and adjustable sliding pole pieces. The component to be tested is placed across the gap between the pole pieces after having been thoroughly cleaned. The current is switched on and a liquid called " detector ink " which contains very finely divided particles of iron is poured over the component. If there is a crack, even a very minute one, the iron particles will collect on the edges, owing to the disturbance of the magnetic flux.

It will be obvious that the " Magna-Flux " method of fault detection is applicable to ferrous materials only. There are, however, a large number of engine components which can be examined in this way, such as crankshafts and camshafts, drives, gears and so forth.

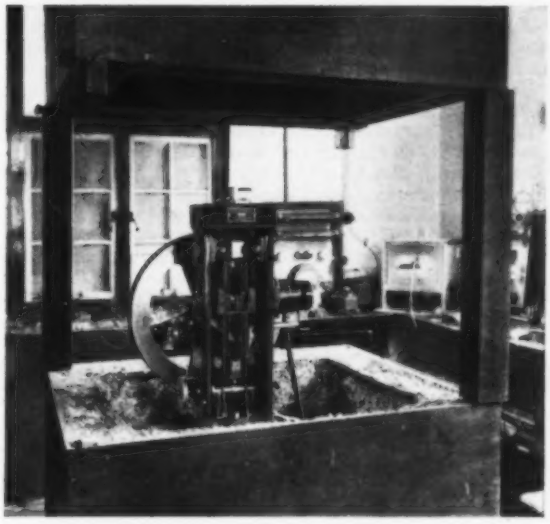


Fig. 7 : Amsler repeated impact machine in the Bristol engine laboratory.

TWO-SPAR CANTILEVER WINGS

A Rapid Method of Obtaining the Stresses in Spars and Skin

By B. B. WALKER, B.Sc.

Introduction

THE cantilever monoplane, having very little parasitic drag, is becoming a very favoured type of design. There are various systems of wing structure, the main problem to be attacked in all of them being that of finding a way of giving sufficient resistance to torsional deflection without undue weight.

One of the commonest and simplest solutions of this is the provision of a skin or wing covering between the spars capable of taking at least shear stress. This, with the spars, forms a tube or set of tubes that can resist torsion. This skin, sometimes forming the whole surface, and sometimes only that portion between the spars, is generally of three-ply wood if the spars are of spruce but of metal if the spars are themselves metal.

The shear stresses in such a skin (composed of a material of which the elasticity is of the same order as that of the spars) are light, and the skin comparatively thin, if it is made just thick enough to keep the twist of the wing under load down to safe limits. At the same time, because of the approach to equalisation of bending deflection of the spars, the stresses in these are lightened by the presence of the skin.

If, however, the skin were designed to take any appreciable amount of *bending* stress it would have to be thickened or stiffened in such a way that its weight would be enormously increased. As a consequence this is not usually done (except in wings in which the skin takes the bulk of the stress and the spars very little), and the problem before the calculator of stress is the finding of a method that assumes the spars alone to resist the bending moments on the wing, while the twist is resisted partly by differential bending of the spars and partly by resistance of the tube formed by the spars and skin. The determination of the proportions in which this division will take place to give equilibrium presents the greatest difficulty, as it is a case of a redundant structure, and the ordinary methods of strain-energy are not applicable.

A first rough method that has been applied is to work out the bending moments on the spars as though there were no skin, and then to assume a certain percentage of bending moment transferred from one spar to the other, the value being empirically decided upon from data as to the position of the centre of pressure and from previous experience. Such a method gives no figure for the stress in the skin, and is necessarily very crude in any case of the slightest novelty in the proportions of spar sizes and skin thicknesses, or in properties of wing section, and a little investigation shows that an even percentage of transference throughout the wing is erroneous.

The more exact methods, of which perhaps the best known is that indicated by Prof. Roxbee Cox in R. & M. 1617, first evaluate the bending moments that would be given to the spars by pure flexure (no twisting deflection) and then by means of expressions based on the average properties of a number of wings, find the bending moments to be added or subtracted for the torsion and the corresponding stress in the skin. In the publication mentioned, the torsion is found by first finding a " flexural line," which is the line upon which the load would have to be placed if there were to be no twist.

For this line two differentiations and integrations of curves are necessary. The line is found for the air load alone, after which the division of the torsion due to this is found. Any torques concentrated at one or two points, such as those due to overhanging engines, are arrived at separately and their effects superimposed.

Such methods thus comprise two portions, the first consisting of the division of the applied loads into (*a*) loads producing pure flexure or similar curvatures of the spars and (*b*) a set of torques, and the second the determination of the effect of these torques. Further, each portion may have to be divided into a calculation for the air load and one for concentrated torques if the necessities of the application of approximations demand it.

In this article there is shown first in Part I a method of finding the system of torques, which is quick and simple and may be applied to the air loads alone or to these combined with those due to concentrated weights. It involves

only one differentiation of a curve, so that cumulative errors are avoided. (The finding of the effects of the pure bending is a simple matter in any method, as for equal curvatures of the spars at any point in the span the spars must be subject to bending moments proportional to their moments of inertia.)

The term "residual torque" is employed in the same sense as in R. & M. 1617 (mentioned above). If we consider the wing divided at any point by a plane at right angles to the centre line of the spars (these being parallel) the loads described as (*a*) above on the section outboard of the plane give a certain total bending moment and shear on the wing structure at the plane. The torques (*b*) on the outboard section give a twisting moment which must be added to give the entire set of actual forces on the inboard section. This couple is the residual torque.

The method of Part I may thus be used to find the curve of residual torque throughout the wing, and other methods (such as that of R. & M. 1617) used for finding how much of this is taken by the spars in differential bending and how much of the residual torque is taken by the skin in shear.

In Part II will be described a graphical method of directly finding the stresses in skin and spars (taking the usual assumption of shear stress only in the skin) without determining the residual torque expressed as a torque but making use of a curve of what is termed here the "unbalanced bending moment," the plotting of which enters into the method of Part I.

In this direct method of Part II the torques of concentrated weights are taken into account with the others due to air loads, as the method begins by the plotting of bending moment curves for the spars as though no skin were present.

Parallel spars are assumed in both parts, but an extension to the case of converging spars could probably be made without much difficulty.

The methods rest on a consideration of the bending moment transferred from one spar to the other by the skin. A "transferred bending moment," found graphically, is added or subtracted to the "independent bending moments," *i.e.*, those given if no skin were present.

PART I—A METHOD OF FINDING THE "RESIDUAL TORQUE"

General

As an alternative to the method of finding the "flexural line" of a cantilever wing, the residual torque* curve for a given system of loading may be found by the following method.

This is quicker than calculation, as the calculation of the flexural line takes some considerable time and this alternative method also gives moment curves that are useful in analysing the spar stresses and in comparing these with those produced by other cases of loads.

These curves also enable a graphical method of finding the actual spar stresses to be adopted. In this method (separately described) concentrated torques such as those due to wing engines may be exactly taken into account. The method is first described and the proof follows.

Method

The air load, c.p. locus, wing weight and any other loads being given, these are converted into distributed and concentrated loads on the spars (as in most usual systems of stressing for biplanes and strutted monoplanes) as though the spars were acting independently with no skin or other means of transferring load from one to the other.

The shear force and bending moment diagrams for each spar are then found for this independent action. These will be referred to as the "independent" shear forces and bending moments. The ordinates of the independent front and rear spar bending moments are then added to give a curve of the total bending moment on the wing.

If at any section of the wing the I_F = the moment of inertia of the front spar; and the I_R = the moment of inertia of the rear spar, values are found for $\frac{I_R}{I_F + I_R}$ (or "R" in Report No. A.D. 3044) and the curve drawn.

The curve is then drawn for $\frac{M\,I_F}{I_F + I_R}$. This is here referred to as the "balanced" bending moment for the front spar, $\frac{M\,I_R}{I_F + I_R}$ being known as the "balanced" bending moment for the rear spar (only one need be found).

The differences between the ordinates of the independent front spar bending moment and the front spar balanced bending moment, give a curve of bending moments, which will be termed the "unbalanced bending moments" at their corresponding points. The slope of this curve at any point, multiplied by the distance between the spars, gives the residual torque.

Thus if M_{IF} is the independent bending moment on the front spar at any point, and M, I_F and I_R have their previous significance,

$$\text{Unbalanced b.m.} = M_{IF} - M\frac{I_F}{I_F + I_R} \quad .. \quad .. \quad (1)$$

$$\text{and residual torque} = d\,.\frac{d}{dx}\left(M_{IF} - M\frac{I_F}{I_F + I_R}\right) \quad .. \quad (2)$$

where d is the distance between spar centres, and x is the distance of any point from the wing tip.

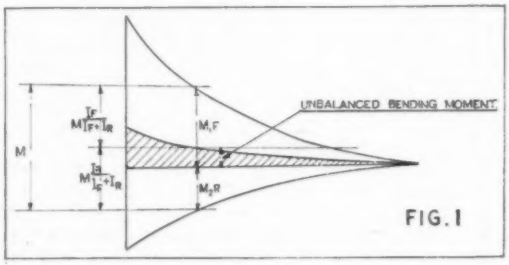


FIG. 1

The unbalanced bending moment at any point can also be found from the differences of the rear spar independent bending moment and the rear spar balanced bending moment, but the signs of the terms must be reversed to give a correct sign for the result.

Thus if M_{IR} is the rear spar independent bending moment, and we write

$$\text{Unbalanced b.m.} = -M_{IR} + \frac{M\,I_R}{I_F + I_R} \quad .. \quad .. \quad (1a)$$

this b.m. is given with the same sign as in (1) and the residual torque may be found from it.

A convenient way of representing these bending moments is that shown in Fig. 1 in which the independent bending moments are plotted with opposite signs on the same axis. The addition of them can then be made graphically, and a graphical check can be made on one of the balanced bending moments after the other is calculated, as the sum of these is also M.

Proof

The residual torque at any section of the wing is the couple which, with certain forces giving no torsional deflection, will complete the system of forces acting at that section due to the loads applied.

The two "balanced" bending moment systems defined by the curves of $M\frac{I_F}{I_F + I_R}$ and $M\frac{I_R}{I_F + I_R}$ and their accompanying shear forces, applied respectively to the front and rear spars, give the same deflection to these spars throughout their length, with no torsional deflection.

* As defined in the Introduction.

The loads that would produce these bending moment curves must be the same in magnitude and lateral position (along the spar) as the actual loads in the wing, since the total actual bending moment M for the existing loads is given at each section by the "balanced b.m. curves." These curves, however, represent different fore and aft (or chordwise) position of the loads that actually exist. To make the two systems of loads identical couples must be added to the "balanced" system to represent the displacement of the loads.

Since the balanced system gives no torsional deflection, these will be the couples giving the "residual torque" as above defined at each section of the wing. The addition of the unbalanced bending moments and shear forces, in opposite senses, to the balanced system, by this assumption gives the actual system.

At any section of the wing, therefore, the forces given by the outboard part on that inboard are the balanced together with the unbalanced bending moments and shear forces added in this way. The unbalanced bending moments cancel each other while the unbalanced shears form a couple. Since the shear force is given by the slope of the bending moment curve, this couple is given by the differential of the unbalanced bending moment at the section multiplied by the distance between the spars. As this couple and the balanced forces (which give no twist) complete the forces due to the actual loads, the couple is the residual torque for the section.

THE BURNELLI AEROFOIL BODY

By Dr. M. WATTER

FOR very many years Mr Burnelli has carried out research and experiment in developing his unorthodox type of aircraft in the United States. Briefly explained the Burnelli system consists in using a fuselage of aerofoil section, which gives remarkable passenger accommodation, and attaching to its sides wings of orthodox design. The Uppercu-Burnelli Corporation of Keyport, New Jersey, has granted to W. S. Shackleton, Ltd., the representative rights for Europe.—ED.

Theoretical Considerations

The problem of distorted aerofoil body-wing combination would seem to present rather complex aerodynamic phenomena, and from a purely theoretic viewpoint its accurate solution is laborious. The writer felt, however, that for all practical purposes in analysing this problem one was justified to resort to the simplifying assumption of algebraically superimposed effects of aerofoil body and wings.

The following features are indicative of small aerodynamic interference supporting the above hypothesis: An examination of the drawing of the latest Burnelli design shows that in view of the continuity of the upper surface of the wing over the body portion it is logical to assume that the outer panels have an effective aspect ratio as if the wings were continuous throughout. As regards the body which has an aerofoil shape but a very small apparent aspect ratio it may be remarked that the presence of outer panels would preclude partial loss of circulation, and besides that the booms would offer a certain amount of end plating so that the effective aspect ratio must be larger than the mere shape would suggest. To evaluate the effective aspect ratio of Burnelli type body the writer assumes an equivalent rectangular wing having the total area of the wing and body and possessing the body chord. It is interesting to observe that this simple assumption was very well verified in two instances by wind tunnel tests despite the use of two entirely different aerofoil body shapes. The satisfactory verification is considered to be definitely supported because of a very close check of the zero lift point, slope of the lift curve and maximum lift as well as the maximum L/D of the models.

Let S_b be the area of the aerofoil shaped body having chord C_b and span b_b, S_w the area of the wings having an average chord C_w and span b. We can write:—

Weight $= C_1QS$ hence for equal landing speed and weight C_1S = const. or αS ($dC_1/d\alpha$ = const. It can be shown (Fig. 1) that $dC_1/d\alpha = A/(1+2/AR)$ where A is an experimental constant.

Aspect ratio of wings $= b^2/S_w$

Aspect ratio of body $= (S_w+S_b)/C_b^2$

In analysing the relative advantages of the Burnelli monoplane design we may make the assumption that half of the body width is indispensable and would be present in any standard design without the benefit of additional lift effect. Let us take a numerical example based on one of the recent wind tunnel tests and representing a 14,000 lb., 14 passenger transport.

$S_w = 587$ sq. ft. through area $S = 163+587 = 750$ sq. ft. $S_b = 240$ sq. ft.; $b = 70$ ft., and $C_b = 20$ ft. The effective aspect ratio can be found from the following equation:—

$S/(1+2/AR) = S_w/(1+2S/b^2) + S_b/(1+2C_b^2)/(S_w+S_b)$

Substituting we find $2/AR = 750/(450+122) - 1 = .31$ ∴ AR = 6.55.

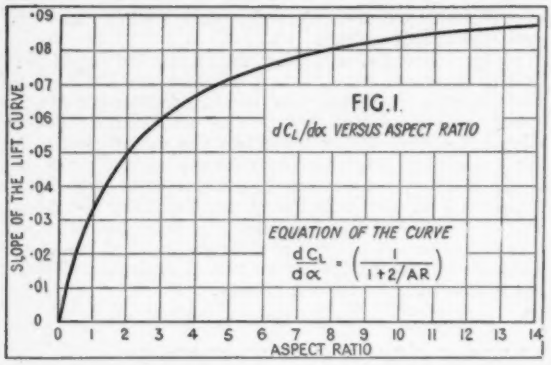
In the case of standard design the semispan of each wing would have been $(70-6)/2 = 32$ and the moment proportional to 32W, while in Burnelli design the moment is proportional to $(70-12) \times 450/572 = 22.7$W or a saving of 27 per cent. with an additional saving in wing area of 158 sq. ft.

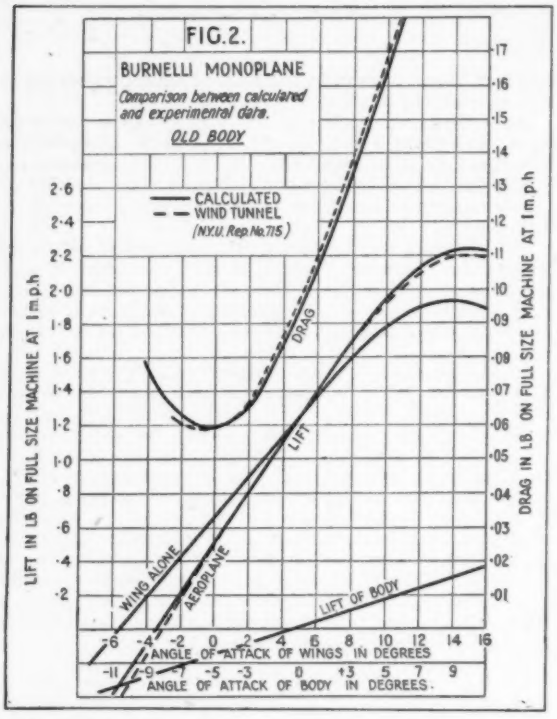
In this case the amount contributed by the fuselage is 26.5 per cent., which of course is conditional upon the fact that the zero lift points of both the wing and body aerofoil lift curves must coincide. A detailed investigation has shown that this condition represents the best comparison from both the aerodynamic and structural viewpoints. It results in practically the maximum obtainable L-max./D-min., gives high L-max. and contributing lift; it results in somewhat higher minimum drag and lower L/D max. than could be obtained by delaying the lifting action of the body to higher angles of the wing. One of the other advantages of this setting is decided simplicity of stress analysis, since the contributing lift effect of the body is constant for all flying conditions. (Fig. 4).

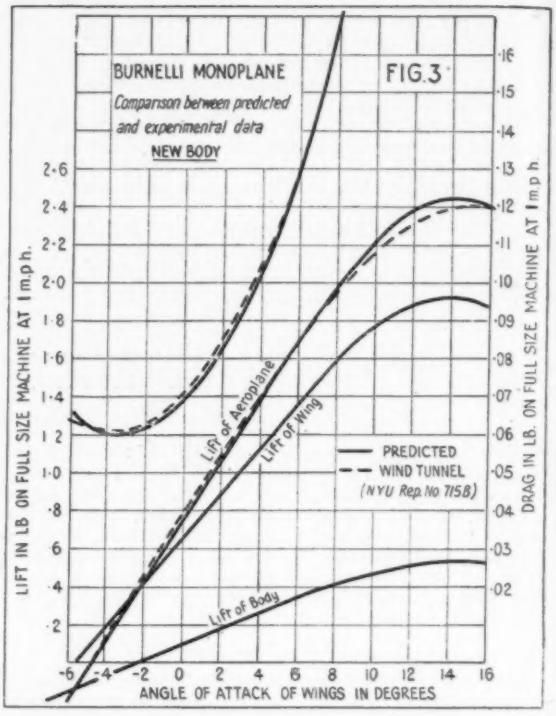
Experimental Verification

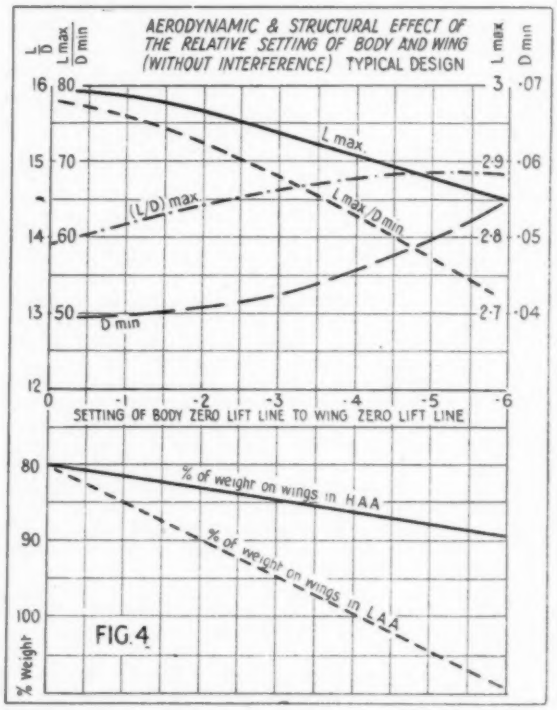
Since all of the above hinges greatly upon the assumptions made, the writer made extensive studies of available experimental data in Mr. Burnelli's files and in every instance found confirmation of the possibility of simple superimposition of body and wing effects since the relative position of the zero lift line, slope of the lift curve and L-max. always check very well. It was decided to attempt to break down the experimental lift and drag curves from the latest test of a Burnelli monoplane as given in the New York University Report No. 715.

The general procedure outlined above was followed to obtain the combined effect of aerofoil body and wing, and it was noted that the zero lift point of the body was shifted considerably in the range of positive angles of the wing. Upon completion of the analysis, which showed remarkably close agreement with experimental data, as can be seen from Fig. 3, is was decided that a better co-ordination could be obtained by approaching closer the two zero lift points. This was confirmed by the study, the results of which are given in Fig. 4. It was further observed by an approximate stability calculation that this arrangement would further lead to an improvement in the condition of downwash with a consequently better stability. To prove definitely all these findings it was decided to design a new body form which would fulfil all the desired conditions and






BURNELLI MONOPLANE
FIG.3
Comparison between predicted and experimental data
NEW BODY
LIFT IN LB ON FULL SIZE MACHINE AT 1 m.p.h.
DRAG IN LB. ON FULL SIZE MACHINE AT 1 m.p.h
Lift of Aeroplane
Lift of Wing
Lift of Body
PREDICTED
WIND TUNNEL
(NYU Rep. No 715B)
ANGLE OF ATTACK OF WINGS IN DEGREES


AERODYNAMIC & STRUCTURAL EFFECT OF THE RELATIVE SETTING OF BODY AND WING (WITHOUT INTERFERENCE) TYPICAL DESIGN
L/D
L max
D min
L max
(L/D) max
L max/D min
D min
SETTING OF BODY ZERO LIFT LINE TO WING ZERO LIFT LINE
% of weight on wings in H.A.A
% of weight on wings in L.A.A
% Weight
FIG.4

locate the wing in such a way as to approach the two zero lift points as close as it was feasible without extensive changes in the wind tunnel model.

The body was made 33 per cent. thicker, since the investigation indicated that this increase could be well afforded because of better co-ordination. Fig. 4 shows the remarkably close agreement of the wind tunnel test (New York University Wind Tunnel Report No. 715B) and the predicted characteristics. The zero lift point checks extremely well while being different from the former zero lift point by 2.5 degrees. The slopes of the lift curves are in very close agreement. From all these investigations, confirmed by experimental verification, it is evident that the simplified analysis gives sufficient practical accuracy. It further proves that interference effect for the case of Burnelli design is negligible, that with properly co-ordinated aerofoil body and wing location the fuselage carries a considerable percentage of lift constant through the whole flying range and easily determinable. Structural significance of this fact is apparent since the weight of the body now becomes useful weight contributory to the lift somewhat in the same sense in which we regard the drag of wings as compared to the parasite drag.

The weight of the wings is reduced partly because of the smaller area required and partly because of smaller wing root bending moments.

The points of safety, accessibility and volume were not touched upon but they cannot be disputed.

In conclusion it can be definitely stated, that for the same aerodynamic efficiency the Burnelli type of design results in considerable saving of weight and for equal weight gives higher aerodynamic efficiency.

AIRCRAFT and RADIO

A Résumé of a Paper Read by Capt. J. M. Furnival Before the R.Ae.S. : The Possibilities of Short-Wave Transmission : Telegraphy versus *Telephony : Direction Finding : Blind Landing Systems*

One of the three Marconi installations at Croydon Airport. (*Flight* photograph.)

IN the course of a paper reviewing wireless and direction finding as applied to commercial aircraft operation, which was read before the Royal Aeronautical Society on December 16, Capt. J. M. Furnival, M.B.E., A.F.R.Ae.S., of the Marconi Company, made some very interesting suggestions and cleared up a number of points which may have been hazy to many people who are interested in air line operation in general rather than in its details.

While dealing briefly with wavelength characteristics, for instance, he suggested that the high-powered long-range stations, which work on a wavelength of 18,000 m., might usefully be employed as homing points for specially equipped long-distance machines. The band allotted for normal aircraft communications was, of course, 822-938 m.

These wavelengths were, he said, subject to "night error," due to the reflection from the Ionosphere. Until the advent of the Marconi-Adcock direction finder, by means of which the unwanted rays could be to a great extent eliminated, this characteristic impaired the value of the D/F service obtainable during the hours of darkness and particularly during the periods of sunrise and sunset.

The Short-wave Trend

Because the band was too narrow, there was a trend towards the employment of intermediate wavelengths, that is to say, those falling below 200 m., for the local communications in inland air services. There were obvious possibilities in the employment of short waves—between 10 and 50 m. These were subject to greater attenuation of the direct ray over the earth's surface, and reflection from the Ionosphere was still more pronounced. The distance from the transmitter at which the reflected ray arrived at the earth's surface varied with the wavelength employed and with the time of the day or night. This distance was also subject to seasonal and regional variation. There was usually to be found a gap or "skip" distance within which the direct ray had diminished, while the indirect ray had not yet returned to the earth's surface. It would be seen that the reflected ray could be received over very great distances.

The dimensions of the transmitting equipment and the aerial system required for the transmission of short waves were small. Furthermore, it had been found that transmission was relatively free from those atmospheric disturbances which impaired the effectiveness of medium-wave communication in tropical regions. The propagation of short and intermediate wavelengths was such that they would freely follow the optical path between any two points, and this effect was of considerable importance and advantage when communicating between ground stations and aircraft flying at fairly high altitudes. As the aeroplane gained height, so the direct ray between it and the ground station was strengthened, and this had the result of minimising the "skip" phenomenon.

Because of the freedom of these waves from atmospheric interference, they were in common use in the tropical regions on long-distance air routes. After daily practical trials over a period of six months on sections of the African route, it was shown that a wave of the order of 45 m. was generally suitable for daylight use on normal route communication, and this wavelength was now in general use. Owing to the fact that the reflected waves arrived at many different angles, it had not hitherto been possible to employ these waves for D/F services, and at present the aircraft on the Empire services were equipped for both medium and short-wave transmission and reception. However, a considerable measure of research had been carried out, and attention was now being directed to means for employing short waves for D/F over long distances. Considerable progress had been made, and the results indicated that a degree of reliability sufficient for the needs of the service would be obtainable when taking bearings either at close ranges on the direct ray or at long ranges on the indirect ray, and that there was a fair chance that the "skip" distance would not be too extensive if flying was maintained at a reasonable altitude.

The problem of accurate D/F depended (said Capt. Furnival) on the elimination of the unwanted ray. This could be effected by means of an Adcock system or by arranging the transmitting signal in the form of a series of pulses, it being possible by this means to detect and take a bearing upon the direct ray, which arrived a fraction of a second in advance of the indirect ray. This and other alternative methods had been under practical observation during recent months. Short-wave receivers were generally more susceptible to "man-made static."

Ultra-short waves were still more attenuated than short waves and were normally free from reflection from the Ionosphere. The optical or "height effect" was very pronounced. If the aircraft was at such a height as to subtend an angle approximately 1 deg. or more with the station on the ground, the rays would follow this free path without considerable attenuation. These wavelengths were not subject to atmospheric interference, and for these several reasons were particularly suitable for local "approach" services, to which they would in the future be extensively applied. The wavelength internationally favoured for "approach" beacons was 9 m., which was the longest convenient wave in the ultra-short waveband. The physical dimensions of the transmitting and aerial system were small, and waves could be concentrated into sharply defined beams.

Future research might reveal possibilities of harnessing for the use of aviation the very short wavelengths known as quasi-optical or micro waves. These waves required still smaller

apparatus and aerials, and might play an important part in the future in the actual landing of aircraft in conditions of poor visibility or for the warning of the dangerous proximity of one aircraft to another.

In normal communication the advantages of the telegraph system were very great. For any given range the apparatus required was lighter and cheaper than that required for telephony. The continuous wave system occupied a narrower channel, thereby using to the best possible advantage the restricted band available. A higher degree of accuracy was obtainable than in the case of telephony, and a remarkable speed of operation was achieved by the use of concise abbreviated codes. Furthermore, the language difficulty was avoided.

On the other hand, there had been found a field of usefulness for telephony. It was possible for the pilot himself to effect the communication, and there was no delay in transcribing and passing the message to the pilot. Useful information could normally be exchanged at a speed of perhaps 100 words per minute, compared with, say, 20-25 words per minute by hand-speed telegraphy. This advantage was of sufficient importance to warrant the added complication even in the case of large aircraft where a telegraphist will always be carried, so that landing instructions could be given direct.

The American System

The very extensive use and the importance attached to radio telephony in America had enforced a high degree of development, leading to reliability and speed of operation, and it was found in actual practice that the continual use of an effective telephone link between pilot and ground, operated in conjunction with the "A and N" equi-signal beacon system regularly marking the routes along which the pilot must fly, had a good effect in establishing a feeling of confidence. There, the authorities employed those medium wavelengths which were best suited for D/F mainly for this purpose, and used an entirely different set of wavelengths, ranging between 50 and 100 m., for telephonic communication. There was much to be said for this arrangement provided that the necessary wavebands were available.

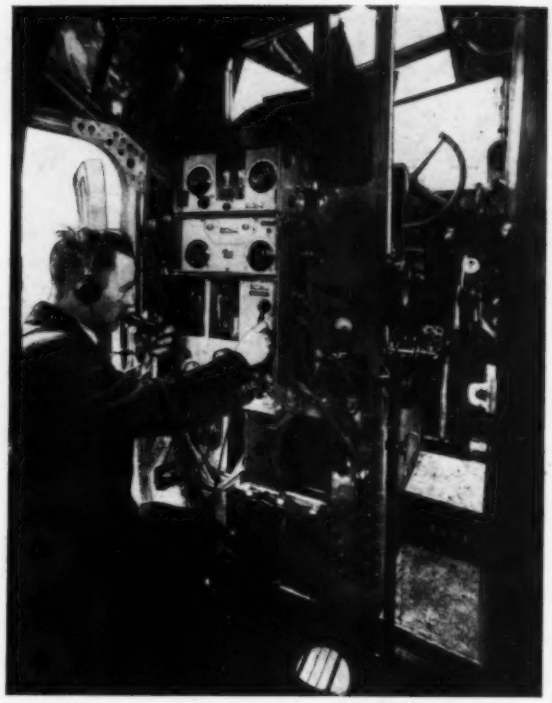
There had also been developed an alternative method of conveying intelligence—the facsimile transmission of written messages, charts or diagrams. It was possible that such a system might have a useful application in the sending of meteorological charts to aircraft, and particularly airships, engaged on long-distance non-stop flights.

Broadly speaking, there were three distinct systems of direction finding, each differing in a marked degree from the other. They were:—(a) The system of ground direction finders, which had been developed to serve the present-day European network and Empire services. (b) The system of directional equi-signal beacons established to mark the chain of air routes throughout the U.S.A. (c) The system of homing, first used on Empire routes and now coming to the fore as an aid to the itinerant flyer.

Each of these systems employed or had been developed from the basic properties of the simple loop of wire which, when turned around on its vertical axis in the field transmitted from a wireless station, gave a maximum response when the plane of the loop was in line in the direction of travel of the waves, and at a sharp minimum when at right angles to the direction of the waves.

The European network was now a highly organised system, comprising D/F receivers associated with suitable transmitting equipment. This system was liable to suffer from overloading and consequent delays under increasing traffic density. A large percentage of the load would be removed by the establishment of the supplementary approach system. Relieved of this load, it was likely that the ground D/F service would continue to act as a normal guiding system for many years.

Concerning the equi-signal beacon system as developed in America, stations were erected at the main airports and at intermediate points for the purpose of marking courses or tracks along the routes to be flown. The pilot listened to the signal



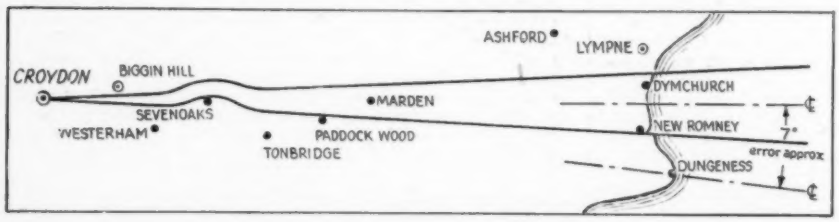
The radio compartment of one of the Handley-Page 42s used by Imperial Airways. The Marconi equipment includes a homing device which can be seen above the normal transmitter.

emitted; when "on course" a continuous musical note was heard; when "off course" this became broken into morse characters indicating "A" on the one side and "N" on the other, signal definition becoming more and more pronounced as the distance from the true course increased. Means had also been developed for indication by visual means. These beacons usually marked four courses, the angular displacement being at 90 deg. to each other, but capable of certain adjustments to meet the needs of routes served. The number of courses could be reduced to two or increased even to twelve by elaboration of equipment. The junction point of two tracks was indicated by a "marker" beacon, and stages along the route might also thus be indicated. Main and marker beacons could be arranged to send telephone broadcasts for the dissemination of weather and other relevant information.

Originally it was envisaged that, by the aid of such a system, it would suffice for a receiving set only to be carried in the aircraft, with resulting economy. Now, however, it was realised that full transmitting and receiving facilities were required, so that in many cases, in addition to the beacon receiver, a separate transmitting and receiving set was also installed, using wavelengths which did not interfere with those allocated to the beacon service.

In certain conditions and over mountainous country, the courses had been found to suffer from bending or splitting. This effect was also noticed to a small extent during the test of the Croydon equi-signal beacon in the vicinity of Sevenoaks, when a distinct bend, due to the nature, or contours, of the ground, and possibly aided by the proximity of power lines, was consistently observed.

To these methods there was the alternative of carrying a



This diagram indicates the effect that hilly country has on an equi-signal beacon course.

directional receiver in the aircraft, thereby permitting the navigator to determine his own bearing or position from any fixed land stations within the range of his receiver. The system was one which had certain obvious advantages and was rapidly developing at the present time. An interesting alternative to the normal D/F system was the "homing" method, in connection with which a fixed directional loop placed athwartship was provided, and the pilot was able, by aural or visual indication, to steer the aircraft in a direct line towards a wireless station. To allow for drift, it was arranged in some systems to adjust the loop to a compensating angle, while other systems provided, by means of a dashboard instrument, an off-course indicator approximately calibrated. Of the two alternatives, the adjustable loop was preferable in larger aircraft, since this permitted both homing and directional services to be carried out if an operator was available. One important factor concerned the phenomenon of night effect, for whereas methods of avoiding this potent source of error were available to land stations, no practical method had been applied to the aircraft direction finder.

Blind Landings

There were at least three approach system methods. The first depended upon the passing of observed data—bearings and proximity—to the pilot from the control station at the terminal aerodrome. The aircraft arrived in the vicinity and was advised of this fact by the personnel of the ground station, who heard the noise of the engines; it turned about and proceeded away from the field in the direction in which the approach for landing should be made. From this point—a few minutes' flying time—the aircraft was guided during its final approach by a series of bearings. This system, known as the "ZZ," might be regarded as provisional.

The next method was that by which a special wireless beacon was installed at the far end of the aerodrome runway and directional equipment provided in the aeroplane—a homing receiver and directional gyro—which was used by the pilot to enable him to steer a course which would guide him to the runway track. Guidance in the vertical plane was left for the pilot's determination by the use of a sensitive altimeter pre-set to the correct barometric pressure; the height was adjusted at the required distance from the runway track. This point was marked by a beacon designed to emit a sharply defined vertical field pattern. As an additional check, a second marker was installed to indicate the boundary of the aerodrome.

In the third system, the directional guidance in both horizontal and, within limits, in the vertical plane, was given automatically from the ground in the form of a track to be followed by the approaching aircraft. The pilot was provided with a simple indicating apparatus which would show him when he was following the desired track.

Some Comparisons

Of the three systems, the first one required individual and co-operative operation between the pilot and the ground staff for each landing attempted. In the second case, beacon equipment was provided, but directional determination was the responsibility of the pilot. In the third system, directional guidance was automatically furnished. The first method utilised the existing apparatus. For the second method, a small power medium-wave automatic beacon was installed at the airport—a relatively inexpensive item of equipment—working in conjunction with ultra-short wave marker beacons. In addition to a homing receiver, the aircraft must be fitted with ultra short-wave apparatus for receiving the signals from the marker beacons.

The third system employed, in one version, ultra-short wave marker beacons and an ultra-short wave track beacon designed to project in the direction of the approach course two overlapping beams, of which one was sent out in a series of long dashes and the other in a series of short dots. Where the two beams overlapped with equal signal intensity a continuous dash was received. Dashboard instruments were provided to indicate to the pilot the signals received from each marker in turn and to enable the pilot to follow the track of the main beacon. By utilising very short wavelengths for this purpose it was possible to project the beam in a vertical plane so that the line of equal field strength along its lower edge approximated as closely as possible to the natural gliding angle of the aeroplane. An additional dashboard instrument was provided which indicated the field strength which must be received by the aircraft receiver if the correct angle of glide—following the contour of the beam—was to be followed. Thus, both horizontal and vertical guidance could be given, but whereas the necessary degree of precision could be guaranteed in regard to horizontal gliding, more experience had yet to be gained in the difficult problem of vertical guidance.

In another version, medium waves were used for the equi-signal track beacon and for the markers. With this arrangement, no form of vertical guidance was given.

According to present methods the main beacon actually marked two courses, one at 180 deg. from the other. The system had been under investigation in this country for some time past and means had been devised by a special arrangement of aerials whereby the unwanted back radiation was eliminated. Beacons having these characteristics were to be tried at the Croydon and Gatwick Airports.

The method by which the track was marked by a medium wave equi-signal beacon had been successfully used in Holland, and the long-range equi-signal beacon installed at the Croydon Airport was being modified for approach work on similar lines. Another medium-wave approach beacon with its markers was being installed at the Liverpool Airport. These aids had the great advantage of requiring no additional equipment to be carried in the aircraft.

While dealing with aircraft and airport equipment, Capt. Furnival gave some interesting and little-known facts.

For instance, trailing aerials, he said, were becoming less efficient as a radiator as speeds increased, because the increased drag reduced their effective height. As machines increased in size, permitting the use of a more effective fixed aerial, it might be possible to dispense with a trailing aerial. In the case of flying boats it was desirable to provide means for elevating a fixed aerial.

In the case of ultra-short wave aerials the vertical one could often be constructed as an integral component of the fixed aerial kingpost, whilst the dipole must be disposed beneath the fuselage, a few inches away from the skin, in a fore and aft line

Modern Requirements

It had been the practice in British commercial aircraft to install the wireless apparatus out of reach of the operator, and to provide remote controls. Modern service requirements, however, necessitated an ever-increasing number of operations to be performed, and provision must be envisaged for switching on and monitoring the ultra-short wave receiving apparatus when this was installed. Hence, it was now usual to allocate a space for wireless equipment immediately behind the first or second pilot, but in front of the forward cabin bulkhead.

Power for driving the generator during flight could be obtained either from the air stream by windmill generator, or from the aircraft L.T. system through a converter, or by direct drive from one of the main engines. It was a fundamental requirement of wireless equipment that it must be available for instant service at any time, and this aspect became a vital issue in the event of engine failure involving a forced descent. This fact limited the choice of power source to the windmill drive or accumulator battery. The increase in speed of the modern aircraft caused the drag of an external generator and windmill to become a serious factor. Where, however, this method was employed, the mounting of the generator in the leading edge of the wing was usually favoured. Regulation was arranged by an automatic variable pitch windmill.

Power Service

As, however, it was now becoming general practice to provide aircraft engines with directly driven low-tension generators, it became immediately possible to design the wireless installation so as to utilise this source of energy, and there was a considerable present-day trend in this direction, high-tension anode converters (which must be flame-proof) being supplied for the wireless transmitting and receiving apparatus, reliance being placed on the main accumulator battery for a reserve of power in case of emergency.

The advent of short-wave and directional services necessitated the provision of receivers which were rather sensitive to interference noises, and it was necessary that a sound bonding and screening specification should be followed.

In the matter of screening the stage had been reached where, with small additional development work, the ignition system of the engine could be fully screened as standard. Very effective screening and bonding was commonplace on American and German aircraft

Capt. Furnival concluded his published paper with a reference to the problems of airport installation and of radio control, and this paper gave some interesting comparisons of aeronautical and marine wireless services

THE ROYAL AIR FORCE

SERVICE NOTES AND NEWS *AIR MINISTRY ANNOUNCEMENTS*

CHANGE IN HIGHER COMMAND

The Air Ministry announces the following appointment:—

Group Captain Philip Babington, M.C., A.F.C., to be Director of Postings at the Air Ministry, with effect from January 1st, 1936, vice Air Vice-Marshal Reginald Percy Mills, C.B., M.C., A.F.C.

Group Capt. Babington was appointed to a commission as 2nd Lieutenant in the Hants Regiment (T.F.) in 1914, and was seconded to the Royal Flying Corps later in the same year. During the war he served in France and besides gaining the M.C., was mentioned in despatches on two occasions. In January, 1919, he was awarded the A.F.C. for distinguished flying services, and in August of that year he was appointed to a permanent commission as Squadron Leader in the Royal Air Force on relinquishing his commission in the Territorial Force. He became a Wing Commander in 1925 and was promoted to his present rank in July, 1932. He has had command of several R.A.F. Squadrons besides holding appointments on both Air Staff and Personnel Staff Duties. Since December, 1931, he has been the Assistant Commandant at the Royal Air Force College, Cranwell.

AIR CHIEF MARSHAL SIR R. BROOKE-POPHAM

The Under-Secretary of State for Air (Sir Philip Sassoon) stated in the House of Commons the other day that Air Chief Marshal Sir Robert Brooke-Popham is temporarily in command of the Royal Air Force, Middle East. Sir Robert's permanent appointment is Inspector-General of the Royal Air Force.

FORMATION OF STATION HEADQUARTERS, ALDERGROVE

A station headquarters will form at Aldergrove on January 14, 1936.

CATAPULT R.N. SHIPS

It was stated recently in the House of Commons that twenty-eight ships of the Royal Navy (apart from the five aircraft carriers) are fitted to carry aircraft. In the U.S.A. navy the number of ships so fitted is forty-five.

COMBINED EXERCISES AT SINGAPORE

The annual combined naval and air exercises have recently been held at Singapore. The R.A.F. units which took part were Nos. 36 and 100 (Torpedo Bomber) Squadrons, No. 205 (Flying Boat) Squadron, and No. 39 (Bomber) Squadron. The last-named is engaged in a normal inter-command flight from Risalpur in India to Singapore. The carrier *Hermes* also took part.

PASSING-OUT AT CRANWELL

The following are extracts from the report of the Commandant of the Royal Air Force College, Cranwell, Air Vice-Marshal H. M. Cave-Browne-Cave, D.S.O., D.F.C., at the passing-out inspection of Flight Cadets, December 1935. The Inspecting Officer was Air Marshal Sir Arthur M. Longmore, K.C.B., D.S.O.

There are 117 Flight Cadets at the College now. Since the formation of the College, and including the term now passing out, 781 Flight Cadets have graduated.

Of the twenty-four Flight Cadets passing out now five are going to Fighter Squadrons, six to Twin-Engined Bomber Squadrons, six to Army Co-operation Squadrons, four to Flying Boats, and three to Torpedo Bombers. As far as possible cadets who go to Flying Boats and Twin-Engined Bomber Squadrons will have been given a short course on twin-engined aircraft here before they go to their units.

Cadets passing out have averaged 63 hours dual and solo on service aircraft, and 156 hr. 35 min. on all types during the course, and they have reached a satisfactory standard of skill.

Instruction in navigation has been on the same lines as that of previous terms, and the standard is up to average. The average number of standard cross-country flights has been six per cadet, but in addition to these a number of shorter triangular flights have been done. During the term only two cadets have forced landed owing to losing themselves on cross-country flights. Both made successful landings. Instrument flying courses have been given to all cadets of the IV Term. The general standard is good. The average flying time on this form of training is 9 hr. 35 min. A start has been made to give instrument flying instruction to cadets of the second term.

Air Marshal Sir A. M. Longmore presents the Sword of Honour to Flight Cadet U/O. M. P. Skinner.

Most of the cadets now passing-out have received instruction in formation flying, war load climbs, and practice of flying on accurate courses for bomb dropping, besides making dummy front-gun attacks on other aircraft and ground targets.

This report only deals with the University entry officers in so far as their instruction affects that of cadets. There are sixteen University officers at present, which is double the number of any previous entry, and the increase in numbers, without a corresponding increase in aircraft and instructors, has hampered the instruction of cadets in instrument flying and on service types.

There has been an all-round improvement in keeness for workshop subjects, although a few cadets still appear to consider that engineering knowledge is of little importance to the General Duties officer.

The total number of cadets admitted to hospital was nineteen, as compared with thirty-three for the corresponding period of last year.

Cadets of the IV Term have been equipped, in the same way as the last IV Term, with blue shirts and forage caps, which have both continued to prove popular and successful.

Awards

His Majesty the King's Medal, presented to the Flight Cadet who obtains the highest aggregate of marks in all subjects in the final order of merit following the passing-out inspection, has been awarded to Flight Cadet Corpl. Patrick Jonathan Kenyon Pike.

The Sword of Honour, presented to the best all-round Flight Cadet in the Senior Term, has been awarded to Flight Cadet Under-Officer Malcolm Phillips Skinner.

The Air Ministry Prize, awarded to the Flight Cadet in the Senior Term obtaining the highest marks in English and History, has been won by Flight Cadet James Allen Chorlton.

The Air Ministry Prize, awarded to the Flight Cadet in the Senior Term obtaining the highest marks in Aeronautical Engineering, has been won by Flight Cadet Sergt. Arthur Reginald Atkins.

The Abdy Gerrard Fellowes Memorial Prize, for the Flight Cadet obtaining the highest marks in Mathematics and Science, has been awarded to Flight Cadet Robert Keith Jeffries.

The J. A. Chance Memorial Prize, for the Flight Cadet in the Senior Term obtaining the highest marks in Service Subjects, has been awarded to Flight Cadet Corpl. Eric Banthorpe.

The R. M. Groves Memorial Prize, for the best all-round pilot in the Senior Term, has been awarded to Flight Cadet A/Sergt. Gerald Elsmie.

ANTI-AIRCRAFT TROOPS

Consequent on the expansion of the anti-aircraft defences of the London area, the Army Council has decided to reorganise the existing system of command and administration in the Territorial Army. This is necessary, it is stated, to provide better facilities for co-operation with the Royal Air Force, and to ensure that training arrangements can be made to the best advantage of all concerned.

The organisation now known as "Air Defence Formations, Territorial Army," is abolished, and the "1st Anti-Aircraft Division, Territorial Army," formed in its place. This Division will, at the outset, consist of four anti-aircraft groups, to which such ancillary services as may be necessary will be added later.

Each group is generally larger than an infantry brigade, and contains anti-aircraft units of the Royal Artillery and the Royal Engineers. The headquarters of the Division are at the headquarters of the Fighting Area, Royal Air Force, Hillingdon House, Uxbridge, Middlesex, and the headquarters of each group will be in close touch with the Royal Air Force formation with which it will co-operate. The new organisation came into force on December 15.

ROYAL AIR FORCE RESERVE

The Air Ministry announces:—

Following the institution last year of the system of direct entry of airman pilots to the Royal Air Force Reserve from civil life, a considerable number of vacancies will arise in the Reserve during 1936. These vacancies provide an opportunity of obtaining free flying tuition and should be of special interest to those who cannot undertake regular service in the Royal Air Force but desire to take their place in the air defence of the country.

Approximately 130 candidates are required to begin training in April and May next and further openings will occur in other courses later in the year.

The initial period of service is five years. Experience of flying is not necessary but applicants must be between eighteen and twenty-five years of age and must be physically fit and of good education. The preliminary instructional course consists of fifty hours' flying; it must be carried out in a maximum period of three months, but pilots may reasonably expect, with good weather, to complete the course in about eight weeks. Entrants are required to do ten hours' flying within a maximum period of ten days in the second half of their first year of service. Thereafter they must carry out twenty hours' flying annually within a maximum period of twenty days. Entrants may also be required to attend a short four- to six-day course at a R.A.F. unit in their second and subsequent years of service.

Vacancies also exist for a number of holders of civil pilots' licences, and applications for entry in this category can be considered from candidates up to their 28th birthday. Applicants are required to pass a qualifying flying test, and those accepted for service proceed direct to the annual training referred to above without undergoing the preliminary instructional course.

Flying training is carried out at civilian flying schools established at a number of aerodromes throughout the country. The instruction is given by qualified flying instructors of the R.A.F. Reserve and takes place on light types of aircraft. The syllabus of instruction includes practice in air pilotage, aerobatics, "blind flying," camera-gun work and photography.

The pay and allowances of airman pilots during training amount to 16s. 6d. a day until qualified as a pilot and thereafter to 17s. 6d. a day. When so qualified they also receive reserve pay and flying reserve pay amounting to approximately £23 10s. a year.

Candidates selected for interview will be required to attend a selection board and to pass a medical examination in London prior to acceptance. Copies of A.M. Pamphlet 56, which contains full particulars as to the method of entry into the Reserve and conditions of service, together with the necessary application forms, can be obtained from the Secretary, Air Ministry, (S.7.(c)), Adastral House, Kingsway, London, W.C.2 on request. Envelopes should be marked "Reserve."

No. 2 FLYING TRAINING SCHOOL, DIGBY

The undermentioned officers and airman pilots have been awarded special assessments as shown hereunder, on completion of a course of *ab initio* flying training at No. 2 Flying Training School:—

Special Distinction

Sgts. G. A. Corby, H. A. Clark, E. L. Bloxham, F. E. Barber.

Distinguished Pass

Acting Pilot Officers.—F. S. D. Burgis, M. P. C. Corkery, P. Stevens, Sgt. Redding, W. G.

SELECTION OF AIRMEN AS PILOTS

The restriction as regards service which was to have applied to airmen recommended after October 1, 1935, for training as pilots will not now be applicable, and the recommendations due at the Air Ministry on April 1, 1936, which are unrestricted as to numbers, may include the names of airmen with not more than five years' service (after completion of trade training), if otherwise eligible. The conditions of eligibility in regard to age and service are re-stated below, the governing date for the calculation of age and service on this occasion being October 1, 1936:—

(i) Airmen must be under 25 years of age;

(ii) They must be able to complete six years' service or be willing to execute such extension or prolongation of engagement as will enable them to complete this period of service;

(iii) Ex-apprentices and airmen of groups I-IV entered as skilled recruits must have over two, but under five, years' service after the completion of trade training (or disciplinary training if trade training is not undergone); ex-group V airmen must have over one year's, but under five years', service in the higher group to which they have been remustered.

ROYAL AIR FORCE GAZETTE

London Gazette, December 17, 1935

General Duties Branch

Lt.-Cdr. C. A. Kingsley-Rowe, R.N., is reattached to the R.A.F., as a Flying Officer with effect from November 3 and with seniority of April 19, 1927; Pilot Officer on probation T. G. Tideman is confirmed in rank (December 2).

The following Flying Officers are promoted to the rank of Flight Lieutenant:—H. A. Simmons (October 13); H. V. Satterly, D. D. Christie (November 19).

F/O. H. L. Tancred is transferred to the Reserve, Class C (December 5); Lt. J. H. T. Boteler, R.N., Flying Officer R.A.F., relinquishes his temporary commission on return to Naval duty (November 8).

Medical Branch

W/O. J. P. D. Agate is granted a permanent commission as Quartermaster and Flying Officer (December 4); Flying Officer on probation J. P. Carlile, L.R.C.P. & S., M.B., B.S., relinquishes his short service commission on account of ill-health (December 14).

ROYAL AIR FORCE RESERVE

Reserve of Air Force Officers

General Duties Branch

M. M. Kaye is granted a commission as Flying Officer in Class C (December 3); F/O. G. B. Musson is transferred from Class C to Class A (April 28).

Erratum

In the *Gazette* of December 3:—*For* John Pegg *read* Arthur John Pegg.

AUXILIARY AIR FORCE

General Duties Branch

No. 603 (CITY OF EDINBURGH) (BOMBER) SQUADRON.—P/O. J. M. Shewell is transferred from No. 602 (City of Glasgow) (Bomber) Squadron (November 1).

No. 607 (COUNTY OF DURHAM) (BOMBER) SQUADRON.—P/O. T. R. T. Carr-Ellison is promoted to the rank of Flying Officer (December 11).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Group Captain.—C. H. Nicholas, D.F.C., A.F.C., to Headquarters, Fighting Area, Uxbridge; for Air Staff duties vice Air Comdre. J. H. S. Tyssen, M.C., 4.12.35.

Squadron Leader.—H. K. Goode, D.S.O., D.F.C., to No. 24 (Communications) Squadron, Hendon; to command vice Sqn. Ldr. J. Whitford, O.B.E., 1.12.35.

Flight Lieutenants.—A. E. Case, to Home Aircraft Depot, Henlow, 9.12.35. A. H. Houghton, to Home Aircraft Depot, Henlow, 9.12.35. J. H. Hargroves, to Superintendent of R.A.F. Reserve, Hendon, 9.12.35. W. R. Sadler, to Headquarters, Air Defence of Great Britain, Uxbridge, 1.12.35.

Flying Officers.—J. F. H. du Boulay, to No. 501 (City of Bristol) (B) Squadron, 10.12.35. D. Addenbrooke, to Station Flight, Abingdon, 16.12.35. J. L. H. Fletcher, to Station Flight, Duxford, 16.12.35. G. A. Bartlett and J. W. Donaldson, to No. 24 (Communications) Squadron, Northolt, 16.12.35. H. W. A. Chesterman, K. F. Ferguson, S. F. Godden, and D. Sloan, to No. 2 Flying Training School, Digby, 16.12.35. G. T. Jarman, J. O. W. Oliver, E. F. Porter, and N. H. J. Tindal, to No. 3 Flying Training School, Grantham, 16.12.35. W. H. N. Turner, to No. 6 Flying Training School, Netheravon, 16.12.35. W. R. Cox, R. N. McKern, W. W. Stainthorpe, and F. H. Tyson, to No. 7 Flying Training School, Peterborough, 16.12.35.

Medical Branch

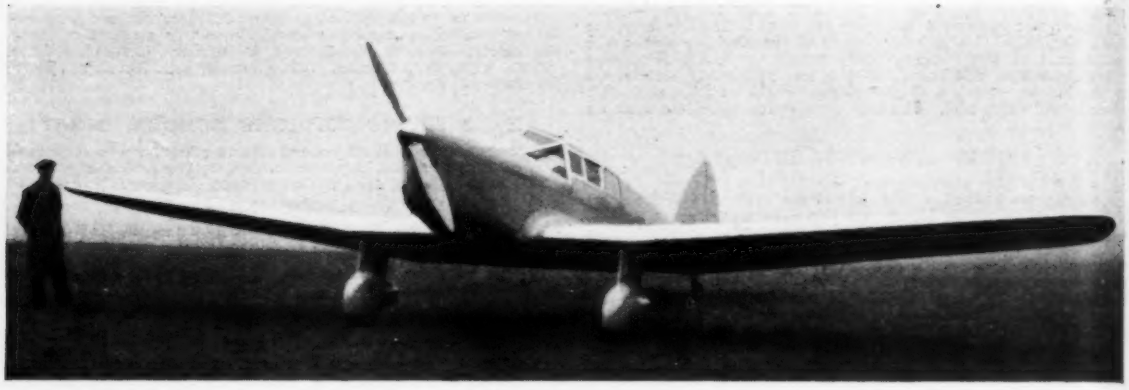
Flying Officers.—C. F. R. Briggs, H. D. Conway, L. M. Crooks, W. J. Fowler, I. K. Mackenzie, H. C. de B. Milne, D. J. Sheehan, and R. F. Wynroe, all to Medical Training Depot, Halton, on appointment to short service commissions with effect from 2.12.35.

Dental Branch

Flying Officers.—R. M. Brown and W. E. Nelson, to Medical Training Depot, Halton; on appointment to non-permanent commissions, 2.12.35.

COMMERCIAL AVIATION

— AIRLINES — AIRPORTS —



SCALED UP. This is the new Percival Vega Gull which was demonstrated at Gravesend last Thursday. Its fuselage and wing are larger than those of the standard Gull and there are four seats permitting side-by-side seating for two pairs of passengers. With a 200 h.p. Gipsy Six the maximum speed is 170 m.p.h.—perhaps rather more—and this fact, linked with the large capacity of the cabin, suits the machine for high speed charter work in addition to its function as an aerial saloon for private owners. (*Flight* photograph.)

THE WEEK AT CROYDON

No Sinecure : A Bad Weather Week : The Faithful Stewards : A Newspaper Feat : Ten Thousand Miles for Christmas

IT has been a difficult week for the air line pilot, who has encountered ice, snow, sleet, fog and gales. I am not sure if we always fully appreciate the wonderful work done by pilots of all nationalities during periods of continuous bad weather. Pilots are a cheerful lot when on the ground, and, by behaving as if they had not a worry in the world, they give us a false impression that theirs is an easy job. Anyone who has been at Croydon recently will realise their difficulties.

Last Thursday was a particularly bad day, and the only machine to reach Croydon was an Imperial Heracles with Capt. Walters in command. It was an excellent show for which the pilot deserves high praise.

Another Lympne "International"

Lympne was the scene of tremendous international activity on Thursday. There were two big Imperial machines there, two of K.L.M., a Ju.52 of D.L.H., an Air France machine, a British Continental Airways machine from Antwerp, and a Hillman machine from Paris. There may have been others there, too, and there were a couple of newspaper machines down at Shoreham.

I do not know how Lympne is organised, or by whom, but the fact remains that Capt. Markam left there for Croydon some time ago, and on Thursday Mr. Dupe, usually a tower of strength on these occasions, had been sent off to inspect aerodromes. These would appear to have little immediate importance when compared with his own station in conditions of weather when one would expect any emergency airport to be fully manned. Lympne is to be congratulated on having an excellent traffic foreman, however, who, despite being understaffed, put up an excellent show, and arranged transport for passengers and freight—no easy task with passengers of seven or eight different companies. The 4.0 p.m. boat train was stopped at Westernhanger and a number of passengers were put aboard.

The value of good stewards was especially noticeable at the station, where those of Air France and K.L.M. were seen arranging matters with the stationmaster, looking after passengers, issuing them first-class tickets, and paying them those little attentions which make all the difference. Not only are air services improving rapidly, but service on air services, is, too, making rapid strides. There was, by the way, a K.L.M. Douglas at Lympne with a stewardess on board. I understand that the company is quite satisfied with this system, though it is early to judge as yet.

Mr. J. W. Duggan, of Wrightways, put up an astonishing show during the week, when he flew to Paris and back on the newspaper service—in thick fog both ways. He landed at Le Bourget with fifty yards' visibility, and flew back to Croydon and landed with much the same weather here. This is one of the things any air line pilot with a completely equipped aeroplane can do, but which no passenger-carrying pilot would attempt.

Miss M. E. Brooke, a charming white-haired lady, young in spirit at all events, travelled out to Nairobi by Imperial Airways, leaving on December 18 and arriving on December 23. She will motor to the middle of a game reserve, where she will spend Christmas with friends, returning also by Imperials, leaving Nairobi on December 27 and reaching Croydon on January 2. The return trip covers about 10,300 miles. Last year she flew to India, and had her Christmas dinner above the Mediterranean in *Scipio*. Sir Samuel Hoare arrived by the first Swissair service from Zurich on Monday, December 16.

British Continental Airways had a queer load recently—a consignment of beer from Lille. Air cargo may yet include coals to Newcastle!

A. VIATOR.

France and the Atlantic

THE Latécoère flying-boat, *Lieutenant de Vaisseau Paris*, has crossed the South Atlantic. Port Natal was reached on Saturday, December 14.

This machine will probably be used for experimental flights across the North Atlantic, and M. Allegre, the director-general of Air France, has announced that these will be started on or about April of next year.

The Prague-Moscow Service

THE Ceskoslovenske Statni Aerolinie have written to explain that the first experimental flight on the Moscow-Prague service was carried out at the beginning of September with an Airspeed Envoy and not by the A.N.T. 9 as reported. The company also states that a Fokker F.7 was used for the third flight because the load to be carried was too great for the smaller Envoy. A regular service should be started in the spring.

An Air Mail Guide

A USEFUL booklet containing information concerning the despatch of normal and air mails to and from Australia is distributed every year by the London office of the Melbourne *Argus*, *The Star* and *The Australasian*. The 1936 edition gives, in addition, lists of steamer sailings, postal information, a track chart of the world, and other useful information. Copies may be obtained from the London office of *The Argus*, 80, Fleet St., E.C.4.

The Irish Transatlantic Base

FOYNES, on the River Shannon and about fifteen miles from Limerick, has been selected as the Irish terminal of the Transatlantic air route, according to a semi-official report in Dublin.

The Foynes district consists of flat land adjoining a big stretch of calm land-locked water on the Shannon. Before the Anglo-Irish Treaty of 1921 it was one of the Atlantic stations of the British fleet. A modern harbour has just been completed at the town, which is the terminus of the Great Southern Railways of Ireland branch line that runs from Limerick.

Hillman's Expansion

AT the first annual general meeting of Hillman's Airways Sir Charles Harris, the chairman, explained that the board had decided on a definite policy of expansion. During the summer the route mileage was increased from 670 to 1,430, and the loss of £39,766 shown in the accounts was, in fact, development expenditure, since it has been the directors' policy not to treat such expenditure as on capital account but to write off all such expenses incurred during the year's working.

Sir Charles pointed out that the inauguration of new services was an expensive matter and sufficient revenue to meet expenses could never be expected in the first two years of operation.

Non-stop to Copenhagen

ACCORDING to *The Times*, British Scandinavian Airways have secured a concession from the Danish Government enabling them to operate a direct non-stop passenger service between London (Gravesend) and Copenhagen (Kastrup). It is expected that the service will be started in February with one service daily in each direction.

A month or so ago, when *Flight* first learnt of the British-Scandinavian plans, these included the use of Blackburn H.S.T. 10s, fitted with Bristol Aquila engines. The H.S.T. 10, it will be remembered, is a high-speed monoplane with the Duncanson single-spar construction, and it was expected that with Aquila engines the cruising speed would be in excess of 200 m.p.h.

The Lisbon Service

CRILLY Airways' new passenger and freight service between Croydon, Madrid and Lisbon, the contract for which was signed by the Portuguese Postmaster-General last week, will be initiated on December 28. Passengers and freight have already been booked for the first trip. The full service will be in operation, it is anticipated, by the beginning of February, when the delivery of the four K.L.M. Fokker machines will be completed.

MASTER PILOT: An impressive view of the pilot's cabin of the Short *Scylla*, with Capt. O. P. Jones at the controls. The next stage will, perhaps, involve a "bridge" for the captain.

As recorded in *Flight* last week, official permission has been given to use Cintra, the military aerodrome at Lisbon, and the Government will establish a special Customs office there and will give Crilly Airways facilities for the erection of offices and hangars. A special series of postage stamps to commemorate the event will also be issued by the Portuguese Post Office. One prominent Portuguese firm has offered a large first cargo of fresh flowers, and has undertaken to give the Company a daily load, and there are other important freight and newspaper possibilities.

The Government have also authorised Crilly Airways to develop internal routes, for which Portuguese capital will be largely available. Certain Dutch mail may also be flown *via* Croydon, and the Portuguese Government has arranged that mail from South America shall be carried.

The direct route, as already reported, will be from Croydon to Bordeaux (for Biarritz), Madrid and Lisbon. By August next year British machines with a speed of 200 m.p.h. will be put into service, and the Fokkers will then be used exclusively for freight.

Skill for the Time Being

THIS is a period of metamorphosis. Yesterday air lines were run on the strength of the skill and experience of the pilots, to-morrow they will be operated with science; to-day the services are expected to be 100 per cent. reliable with only a very little scientific assistance.

Time after time the Hillman—or, as they are now, British Airways—pilots have brought machines into Stapleford Abbotts Aerodrome without radio assistance in thoroughly bad weather. Last Thursday conditions were too bad even for that, and a B.A. pilot brought a D.H. 86 into Gravesend from Paris with a visibility of less than a hundred yards. The watchers on the tarmac simply waited for the 86 to taxi out of the mist.

Perhaps air line pilots have developed a couple of new senses.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for publication in these columns.

TOUCHÉ!

[3097]—You announce that the Air Ministry is about to carry out some "high-speed research" with the Miles Hawcon, but that is very ambiguous. Certainly it would inspire us all with awe to see that body of infinite mass, the Ministry, moving with even reasonable velocity—let alone high speed. That would make even the States tighten the turnbuckles of their socks. W. E. GRAY.

London, W.1.

THE INGENIOUS COLONEL TEMPLER.

[3098]—Perhaps you may like to know more about Col. James Lethbridge Brooke Templer (1845-1924), who is dealt with in Major F. A. de V. Robertson's excellent book on the R.A.F., which you have just published.

Born in 1845, he was the eldest of the four sons of James Templer (1814-74), a master in the Court of Exchequer, who married Hannah Frances Gordon (1813-89). This lady was the eldest daughter of Admiral Sir James Alexander Gordon (1782-1869), a member of the family of Gordon of Wardhouse, Aberdeenshire, who, to-day, in the main line, are largely Spanish. The Admiral was a remarkable old fellow who is dealt with too briefly in the Dictionary of National Biography. He was the subject of a glowing article, "The Last of Nelson's Captains," which Tom Hughes contributed to Macmillan's Magazine (February, 1869). The Admiral was the last governor of Greenwich Hospital, and Hughes shows the same sort of courage as Templer displayed. Templer's sister Dora (d. 1919), married Otto Peiniger, for many years the violin master at Harrow School.

Col. Templer was in the 7th K.R.R.C. Militia. I believe his quarters at Aldershot were the first to be heated by steam and lit by electricity. That is an illustration of the same adventurous spirit as suggested by his ballooning for the army. J. M. BULLOCH.

London, W.C.

POWER FOR THE "POU."

[3099]—In connection with the recent "Flying Flea" craze the amateur constructors of these appear to have overlooked what is, to my mind, an almost ideal engine for such aircraft. The engine to which I refer is the Ariel Square Four motor cycle engine. For those who do not know this engine I may say briefly that it consists of four cylinders arranged in a square formation on two geared crankshafts.

In motor cycle trim it weighs about 110 lb., and develops 30 b.h.p. at about 5,900 r.p.m. For sheer acceleration I do not know of any engine that can beat it.

For aircraft work I should say that such an engine could easily be adapted by strengthening the gears to the half-time shaft and taking the drive off this point, via a suitable thrust bearing which could be easily incorporated.

I do not see why its weight could not be reduced to 80 lb. by the elimination of one flywheel, and the lightening of three others (the prop supplying the necessary flywheel effect), this weight including the oil sump, which is integral. Its overall dimensions are about 18in. high by 12in. by 12in., and there are no awkward projections.

If any amateur has used such an engine in a "Flying Flea" I would be glad to hear from him. As far as motor cycle work is concerned the engine is utterly reliable.

Maji Moto, P.O. Musoma, Tanganyika Territory. A. M. GODFREY.

THE G.E.'s CHRISTMAS VISION

The above entertaining Christmas card is from an artist friend who has been studying this drawing of the Lockheed Vega. Seekers after a moral may find one in the left-hand bottom corner.

EINSTEIN on EXPANSION?

ONCE upon a time somebody who was believed to Know Something About It was commanded by the Dwellers on Olympus, W.C.2, to draw up a Specification for an Ideal Bomber; the which, being Anxious to Please, he did forthwith.

Now, it so happened that the Knowledgable Person lived and worked in company with a lot of Rude Little Boys, who, though they were admittedly adept in the art of Aerial Bombardment, were sadly lacking in respect for the Knowledgable Person, and even more so for the Dwellers on Olympus, W.C.2.

One day the Rude Little Boys, quite uninvited, drew up an Ideal Bomber Specification of their own accord. And this is what they said:—

"(1) The speed of the bombing aircraft must be slightly in excess of the speed of sound, *i.e.*, 1,500 m.p.h. This would enable the aircraft to be half-way on its return journey before the enemy heard it approaching. Sound locators would therefore be baffled.

"(2) The bomb must be propelled from the aircraft at a speed in excess of the speed of light. This is considered essential in use against ships, as the bomb would reach the objective before observed to leave the aircraft. Avoiding action would thus be rendered impossible.

"(3) If the speed of the aircraft is in excess of 1,000 m.p.h. it could take-off, release its bombs, and, if the target is to the west, the bombs will strike the target to-morrow; if to the east, yesterday. In view of this it is essential that when advanced landing grounds are being sited every effort should be made for the sites to be to the west of enemy country. In this way the enemy will be given a false sense of security, as, on seeing no bomb fall from the aircraft, he will think that he is not being bombed, when in actual fact he was bombed yesterday or to-morrow, depending upon whether the machine is operating from an aerodrome east or west of the target. Adding to this confusion, the bomb will burst before it is observed to leave the aircraft (see para. 2).

"(4) In order to baffle interceptors, bombers should, if possible (and this, it is felt, may present serious difficulties), fly at a speed faster than light. They would then be observed 'coming' when in actual fact they would be 'going.' An aircraft of this description would, it is suggested, be invaluable to inspecting officers."

AN INTERESTING TWO-STROKE DESIGN

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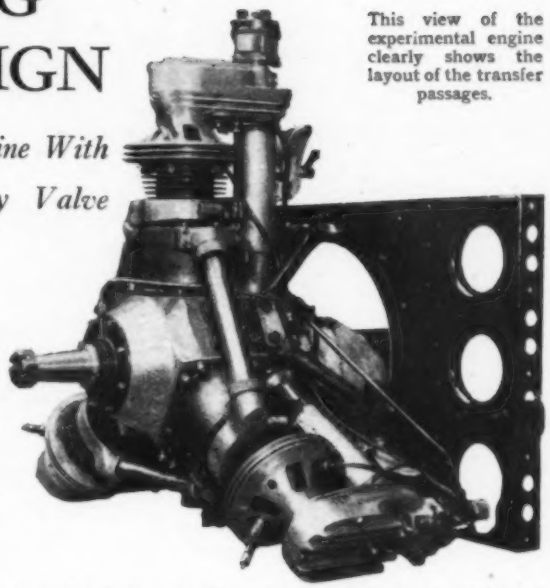


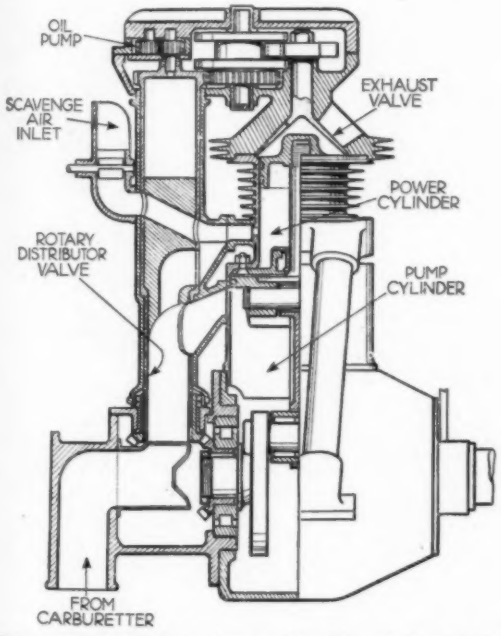
This view of the experimental engine clearly shows the layout of the transfer passages.

FOR a number of years the supercharged two-stroke has been the automobile engineer's idea of temporary perfection in the matter of power units. Mechanical or thermal problems have, however, so far been insuperable, and the two-stroke of any type has made very little progress in really high-efficiency forms.

However, it would appear, from a purely theoretical point of view, that the use of poppet valves might eventually limit the development of the internal combustion engine as we know it. Any prime-mover, therefore, which shows promise of successful development on new lines should be seriously considered.

Several engines in the past have employed the double-diameter piston for charging purposes, but in the engine described—which, in its present form, is a three-cylinder radial—each charging piston forms a crosshead, relieving the working pistons of side thrust. A double-pumping action is obtained in which practically the whole area of the charging piston is used on the up stroke, and that of the underside of the power piston on the down stroke. A supercharging effect is thus possible without the employment of very large diameter pistons.

The charging of any power cylinder is effected by means of the charging cylinder adjacent to it and having its piston phase 120 deg. behind it in the direction of rotation. In this way, when the power piston is on bottom dead centre and moving at its lowest velocity during the charging period the charging piston serving it is moving at high velocity and forcing the fresh charge with the absolute minimum of pumping loss.



This sectioned drawing gives a clear idea of the general layout of the experimental engine. The semi-rotary cone valve has a form of Maltese Cross drive.

The distribution in the charging cylinders is controlled by a vertical rotary distributing valve situated behind each cylinder and this also serves as an induction pipe and a transmission shaft for the exhaust valve operating gear. Each rotary valve is driven from the rear end of the crankshaft by bevel gearing.

In order to reduce negative work, the pressure in the transfer pipe and belt at the end of the charging period is relieved by a by-pass port in the rotary valve, feeding into a part of the induction system which is not under pressure, and, before fresh mixture is admitted to the charging cylinder, pure air is drawn into the transfer belt and pipe. This serves the purpose of initially scavenging the power cylinder when the charging ports are first opened and prevents any fuel wastage. The charging period is controlled entirely by the ports in the transfer belt, the direction of flow being controlled to give a tangential entry and consequent high turbulence. The angle of opening is quite short in comparison with normal two-stroke practice, but has been found adequate in conjunction with the charging methods employed.

The Exhaust Valve

The usual method of timing exhaust ports by the piston movement would make supercharging impossible and would also complicate the matter of keeping the exhaust separate from the fresh charge. The exhaust outlet is, therefore, situated at the cylinder head and is controlled by a mechanically operated valve. This valve is an interesting feature of the engine. Its motion is semi-rotary and it is effectively cooled and lubricated, while its mechanical operation appears to absorb very little power. By means of a "stop and go" drive similar to that once employed in cinematograph projectors, this rotary cone valve is made to uncover a number of ports at each second movement.

In spite of the teething troubles which are invariably associated with any new departure in engine design, the experimental engine shown has put up a very promising performance, though no actual brake test figures are yet available. According to airscrew calibration figures, however, an output of 20 h.p. at 2,200 r.p.m. has been obtained; the capacity of the engine is only 520 c.c., and in view of the very low piston speed represented by this speed it is evident that this power could be considerably improved upon.

The all-in weight of the engine, including single ignition, is 85lb., and this should be considerably reduced with attention to minor points of design. Maximum loadings are extremely low on all vital parts, and in runs making up an aggregate considerably in excess of 100 hours, no mechanical trouble or heat difficulties have, it is claimed, been experienced and no measurable wear has taken place. Further details of this interesting engine can be obtained from Mr. E. W. Lamb, of 141, Eastcote Road, Ruislip, Middlesex.

THE INDUSTRY

Carburetter Expansion

AS a result, chiefly, of the success of their vee-type car carburetter, the Zenith Carburetter Co., Ltd., has just moved into extensive new offices and works at Honeypot Lane, Stanmore, Middlesex.

A Vacuum Eagle

A B. A. EAGLE with Gipsy Major engine, G-ADYY, has recently been purchased by the Vacuum Oil Co., Ltd., to be used mainly in connction with the firm's interests abroad. It was put into service recently, when Mr. H. J. White, of the Socony-Vacuum Oil Company, Inc., left Paris to carry out a survey of the Sabena Sahara route, for which Vacuum has recently been awarded an important contract.

Antipodean Mission

MR. W. S. ("BILL") SHACKLETON, of W. S. Shackleton, Ltd., the well-known aeronautical consulting engineers of 175, Piccadilly, London, W. 1, is to leave England at the end of this month for Australia and New Zealand by way of America. He will return by a similar route about three months later.

While this visit is chiefly in connection with his firm's own interests, he will be able to carry out commissions, of a non-competitive nature, on behalf of concerns in the aircraft industry.

Hollow Rivets

THOUGH so small in themselves, rivets play an extremely important part in the construction of metal aircraft, and an interesting accessory in this connection is the hollow rivet made by the George Tucker Eyelet Co., Ltd., of Jameson Road, Aston, Birmingham, 6. This firm is on the Air Ministry list for the supply of hollow rivets made from stainless steel (D.T.D. 189), and aluminium alloy (D.T.D. 209a), and they also produce them from mild steel.

These rivets are claimed to have considerable advantages, and the George Tucker Company is at present supplying them to the trade in large quantities.

PUBLICATIONS, ETC., RECEIVED

International Index to Aeronautical Technical Reports, prepared by the S.B.A.C. Price 5s. Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, London, W.C.2.

Flight, the Story of Aviation in Pictures and Text, by Agnes Rogers. Price 7s. 6d. Harper and Bros., 90, Gt. Russell Street, London, W.C.

Stratosphere and Rocket Flight (Astronautics), by C. G. Philp. (2nd edition). Price 3s. 6d. Sir Isaac Pitman and Sons, Ltd., Parker Street, London, W.C.2.

Encyclopædia of Aviation. Compiled and edited by Squadron Leader C. G. Burge. Price 15s. Sir Isaac Pitman and Sons, Ltd., Parker Street, London, W.C.2.

Technical Publications of the International Tin Research and Development Council: Number 23: Striations in Tin Coatings on Copper. By B. Chalmers and W. D. Jones. Manfield House, 378, Strand, London, W.C.2.

Miscellaneous Publications of the International Tin Research and Development Council: No. 4: Tin and Its Uses. By D. J. Macnaughtan. *No. 5: Tin and Civilisation*, by D. J. Macnaughtan. *No. 22: Series A, Improvement in The Quality of Tinplate by Superimposed Electrodeposition of Tin*. By A. W. Hothersall and W. N. Bradshaw. *No. 24: The Atmospheric Corrosion and Tarnishing of Tin*, by L. Kenworthy. *No. 25: Electrodeposition of Tin Alloys from Alkaline Stannate Baths*. By R. G. Monk and H. J. T. Ellingham. Manfield House, 378, Strand, London, W.C.2.

High-Speed Diesel Engines, with Special Reference to Automobile and Aircraft Types. By A. W. Judge. Price 15s. Chapman and Hall, 11, Henrietta Street, Covent Garden, London, W.C.2.

Grand Prix. By Barré Lyndon. Price 7s. 6d. John Miles, Publisher, Ltd., Amen Corner, London, E.C.4.

Corrosion and Heat-resisting Steel Products, Firth-Vickers Stainless Steels Ltd., Staybrite Works, Sheffield.

Bearing Bronzes (Engineers' Notebook Series). Copper Development Association, Thames House, Millbank, London, S.W.1.

Technical Aerodynamics. By K. D. Wood. Price 21s. *Structural Design of Metal Airplanes*. By J. E. Younger. Price 24s. McGraw-Hill Publishing Co., Ltd., Aldwych, London, W.C.2.

Kempe's Engineer's Year Book, 1936. 42nd edition. Price 31s. 6d. Morgan Bros. (Publishers), Ltd., 28, Essex Street, Strand, London, W.C.2.

AERONAUTICAL PATENT SPECIFICATIONS

(The numbers in brackets are those under which the Specifications will be printed and abridged, etc.).

(*Published December* 19, 1935.)

14816. CIERVA AUTOGIRO CO., LTD., and BENNETT, J. A. J.: Blades for aircraft sustaining rotors (438,660).

14817. CIERVA AUTOGIRO CO., LTD., and BENNETT, J. A. J.: Aircraft with rotative wings (438,525).

15541. LORENZ AKT.-GES., C.: Directional radio transmitting particularly applicable for determining bearings (438,804).

4328. BIRKIGT, M.: Double internal-combustion engine units for aircraft (438,687).

8535. ELEKTRONMETALL GES.: Aeroplane undercarriages (438,770).

(*Published December* 27, 1935.)

9053. PILAIN, R.: Sighting correction apparatus for guns mounted on aircraft (438,956).

16117. BENDIX AVIATION CORPORATION: Brakes (439,123).

16163. DAVIS, Sir R. H.: Breathing apparatus for the use of airmen, miners, and others (439,183).

16251. DOWTY, G. H.: Internally-sprung wheels for aircraft (438,968).

51976. BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE CO.: Power operated gear-shifting mechanism (439,075).

CHANGES OF NAME.

EAGLE GLIDING AND FLYING CLUB, LTD., 109, Colmore Row, Birmingham.—Name changed to Birmingham Gliding and Flying Club, Ltd., on November 15, 1935.

HIGH POWERED AERO ENGINES, LTD., King William Street House, Arthur Street, London, E.C.4.—Name changed to High Powered Aeronautical Engines, Ltd., on November 13, 1935.

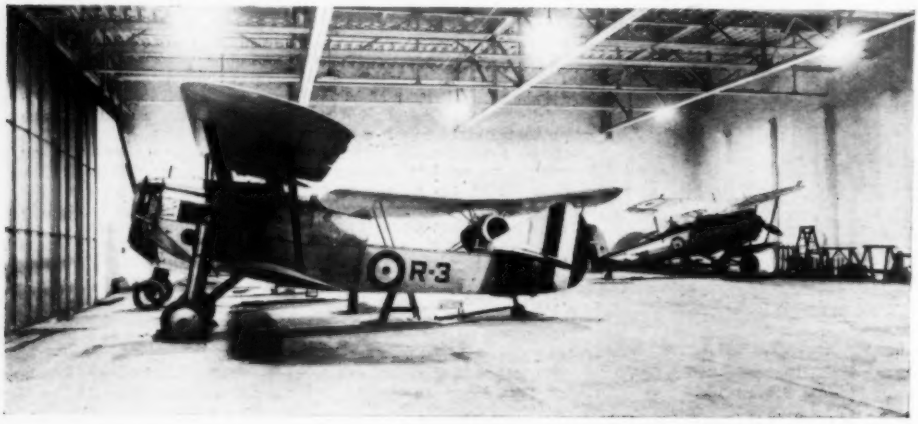
YORKSHIRE AVIATION SERVICES, LTD. (Newton House Hotel Aerodrome, Londonderry, Northallerton).—Name changed to Yorkshire Aviation Services Country Club, Ltd., on December 2, 1935.

NEW COMPANIES

In the notes below, for reasons of space, the "objects" of new companies are usually somewhat abbreviated.

EASTBOURNE FLYING CLUB, LTD. (308,128).—Private company, registered December 13. Capital £1,250 in £1 shares. Objects: to carry on the business of aerial transporters of passengers and goods, to act as club proprietors, etc. The permanent directors are: Tom G. Stubley, Knowsley, Corner, Dukes Drive, Eastbourne; Harry A. Love, Priory Cottage, Wilmington, Sussex.

WESTERN AIR TRANSPORT LTD.—Private company, registered December 12. Capital £4,000 in £1 shares. Objects: to purchase such of the present or future debts due or owing or to become due and owing by Norman Edgar (Western Airways) Ltd., of 40, Broad Street, Bristol, as the company shall deem fit; to operate air lines. The subscribers (each with 1 share) are: Norman W. G. Edgar and Harry Crook. The first directors are to be appointed by the subscribers. Registered office: 40, Broad Street, Bristol.



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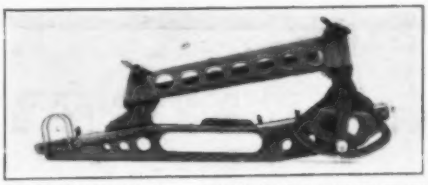

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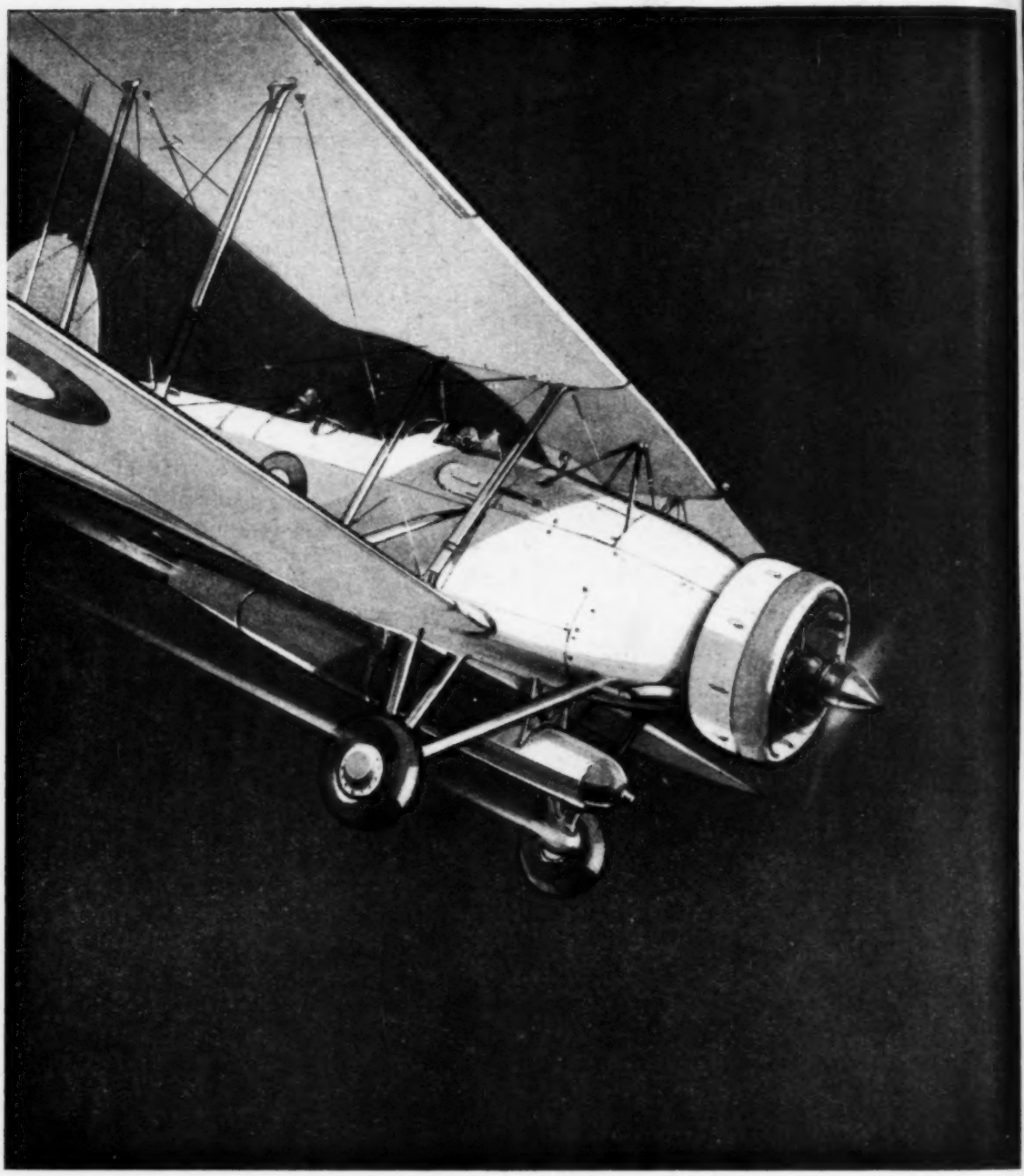

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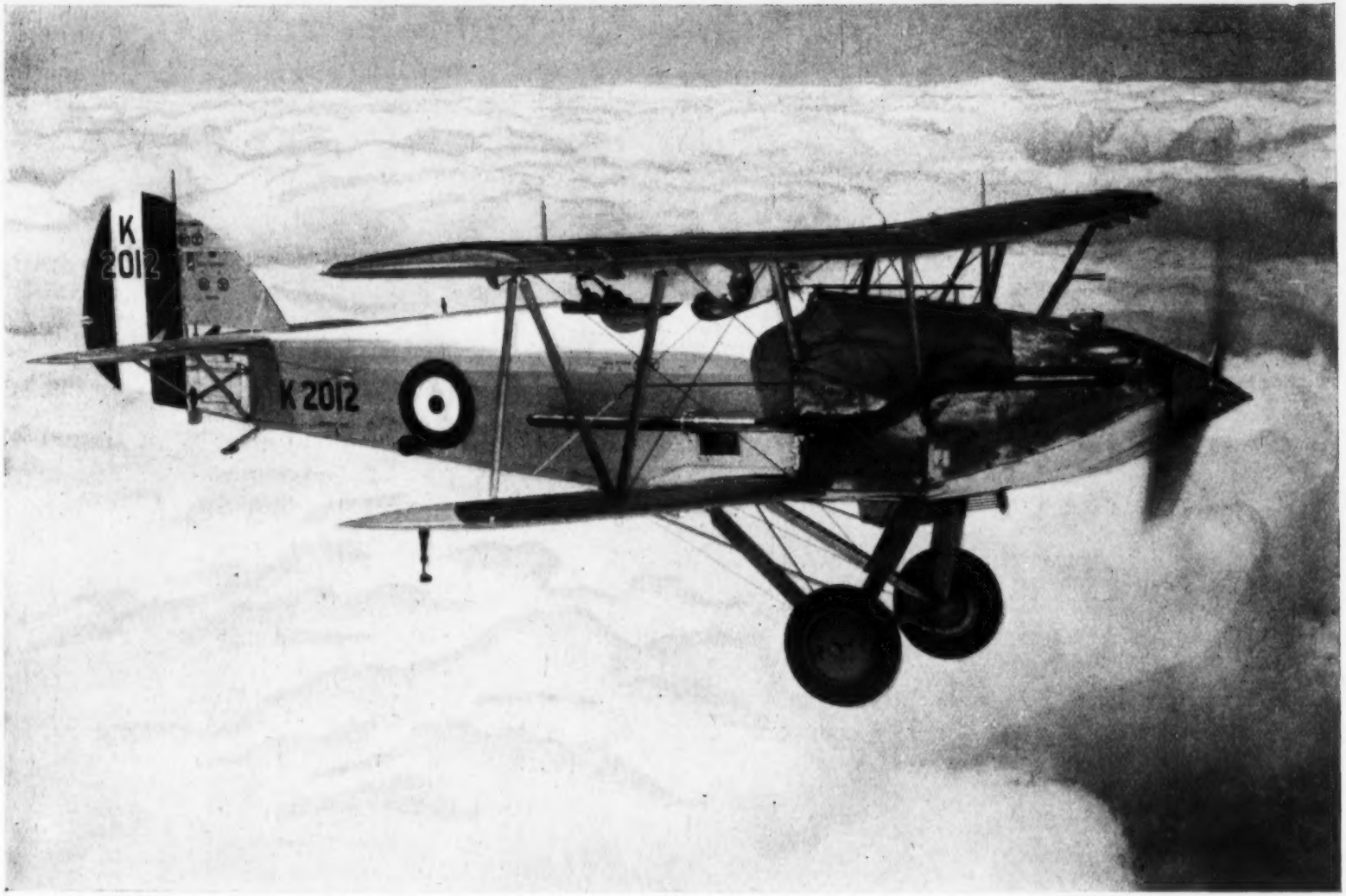

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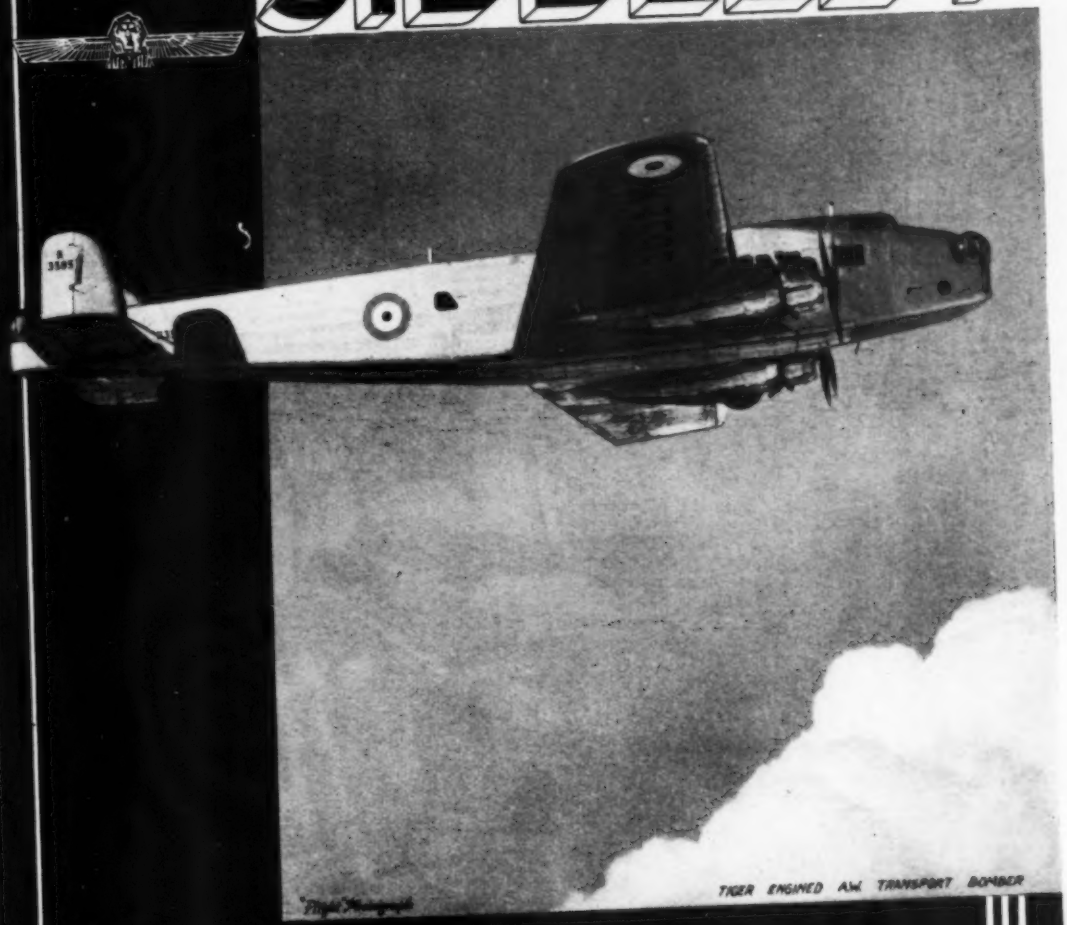

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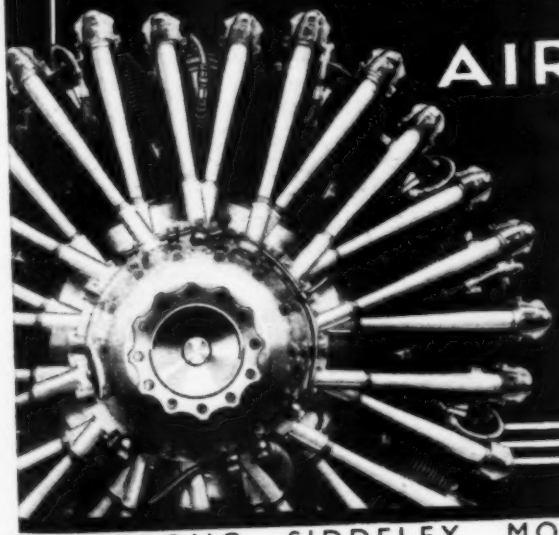

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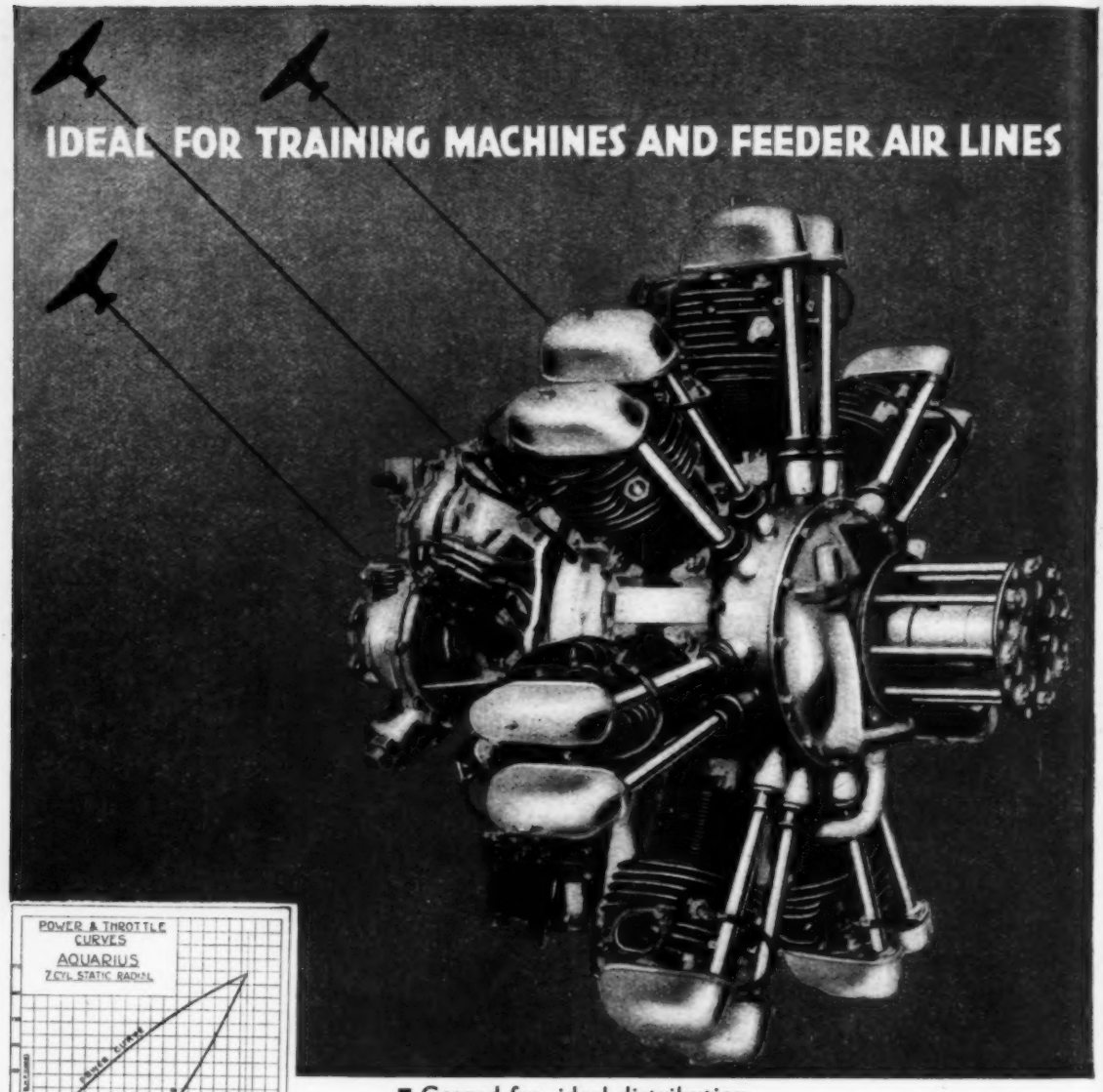

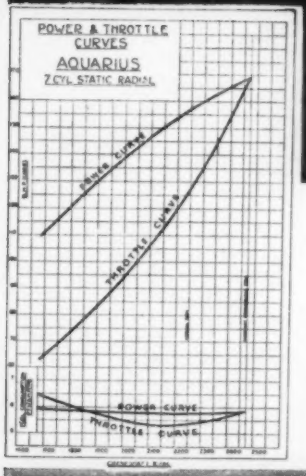

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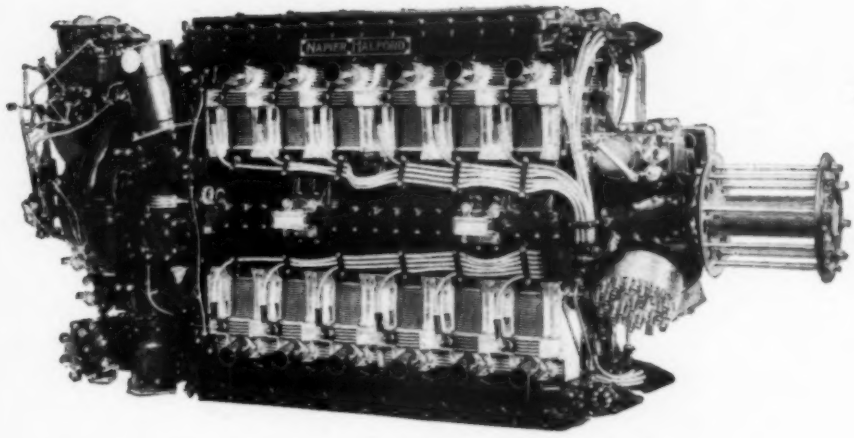

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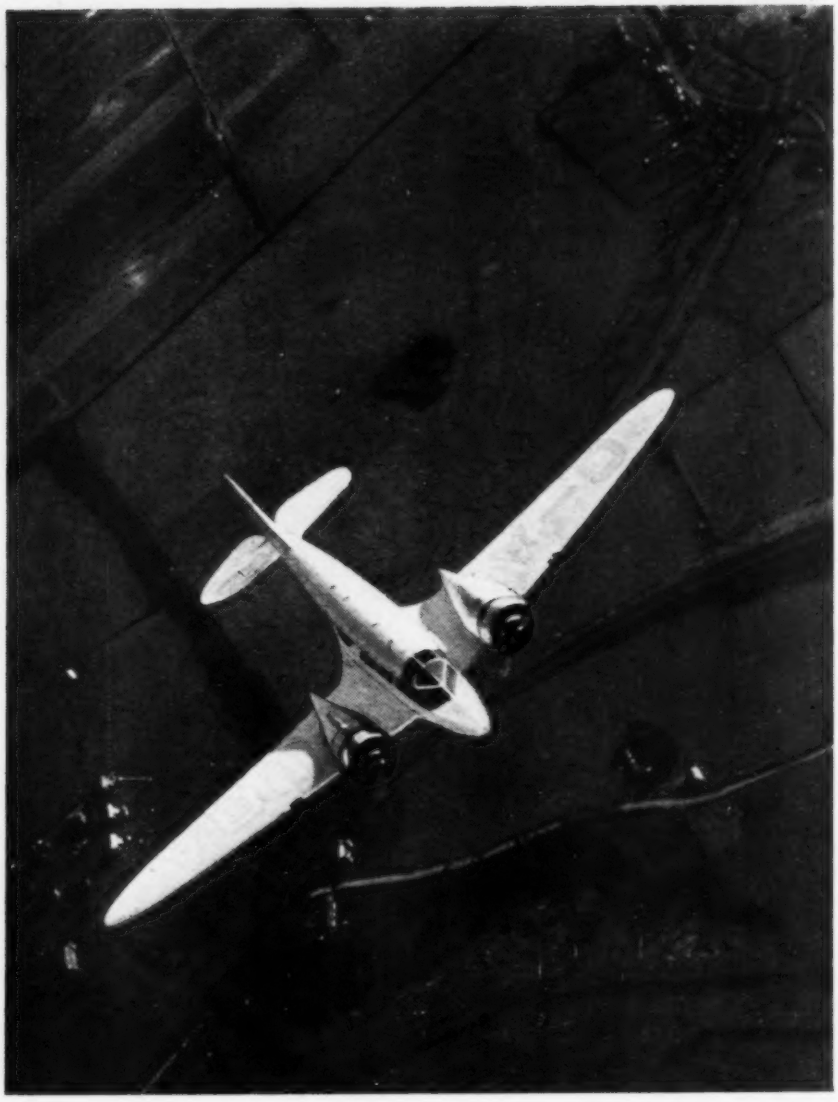

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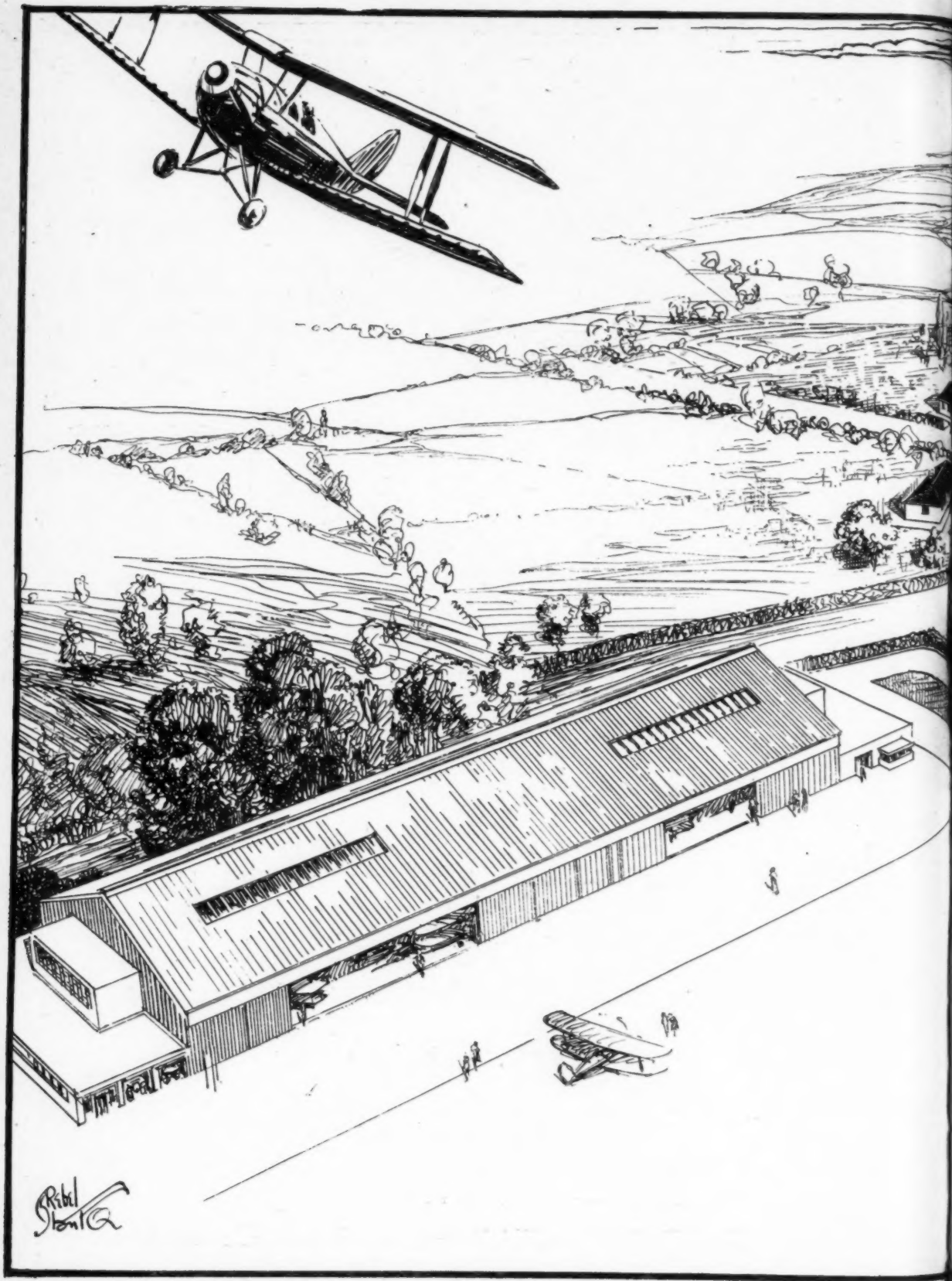

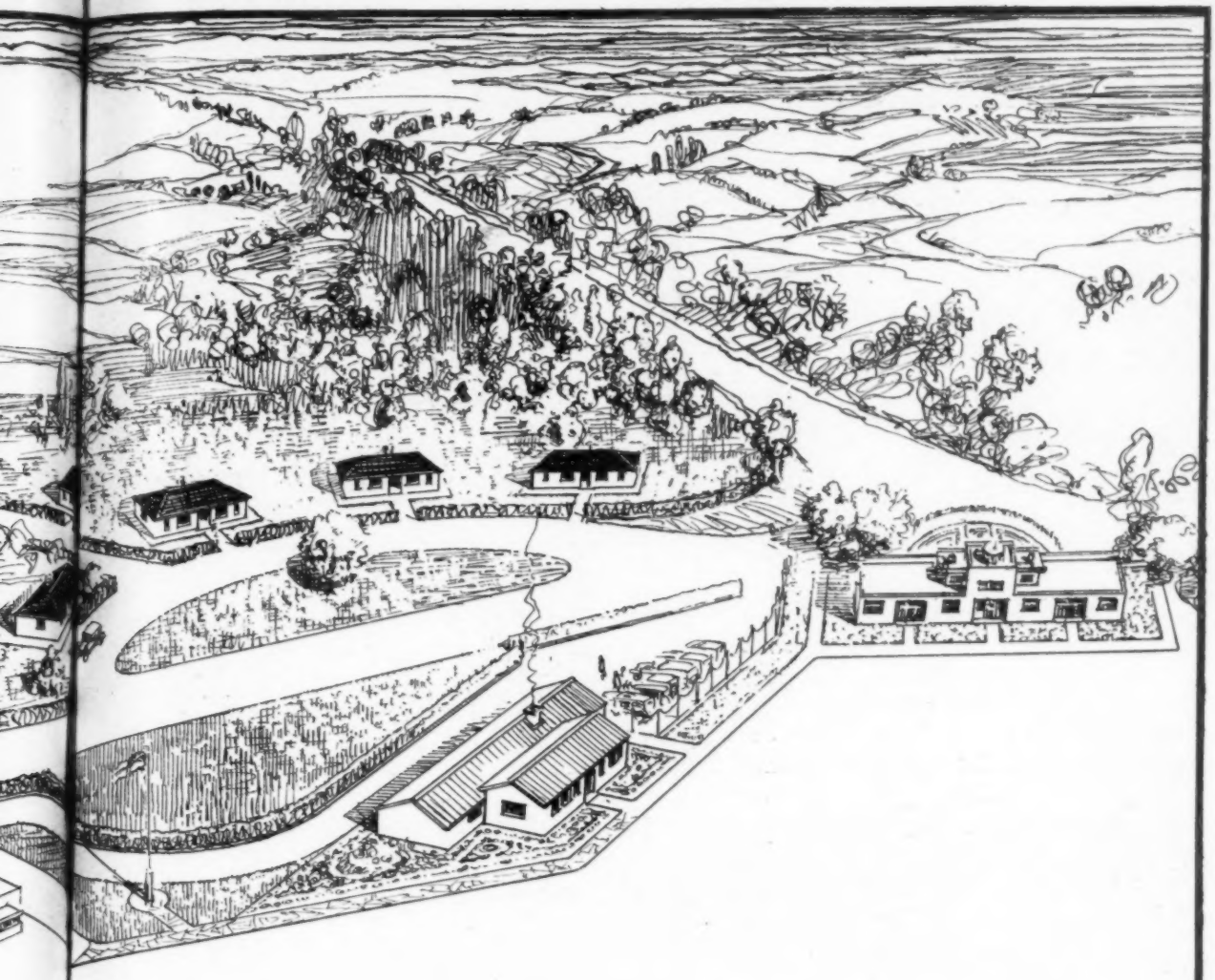

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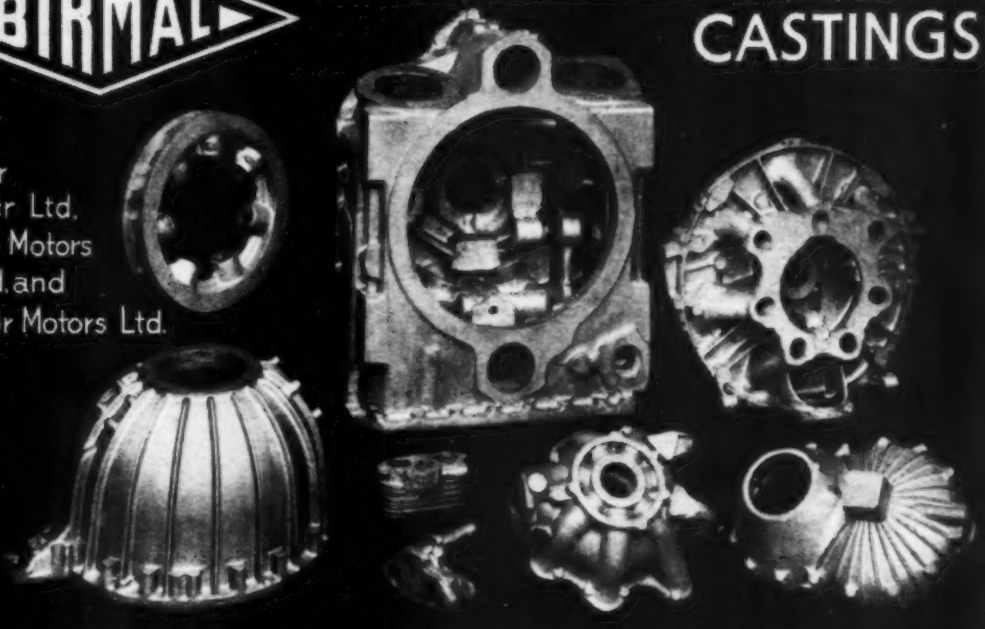

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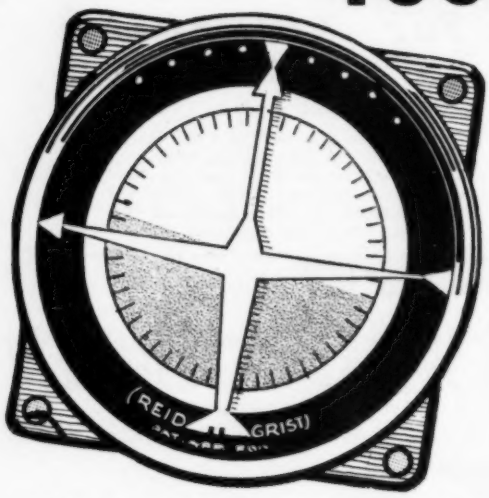

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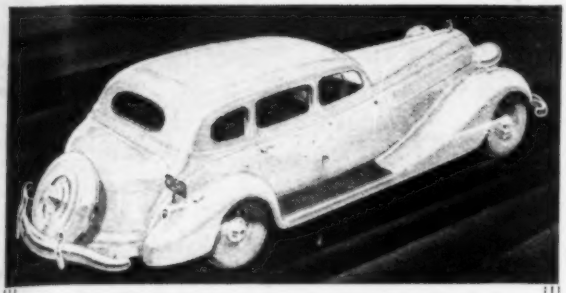

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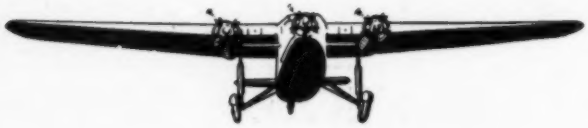

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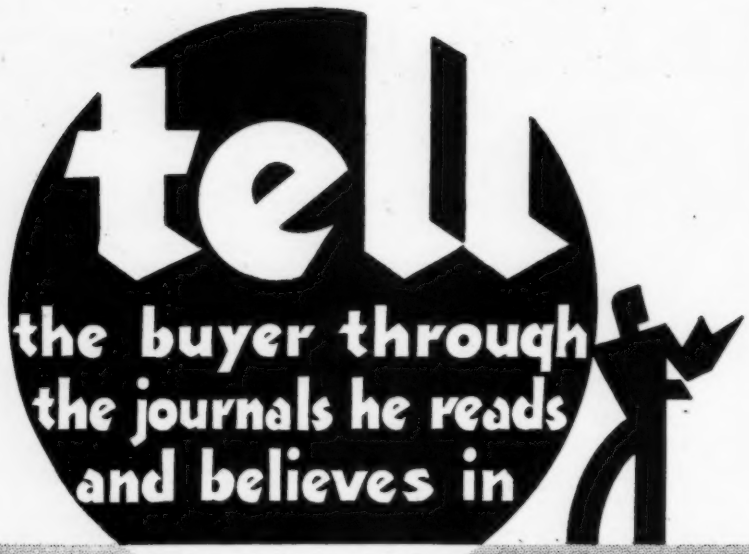

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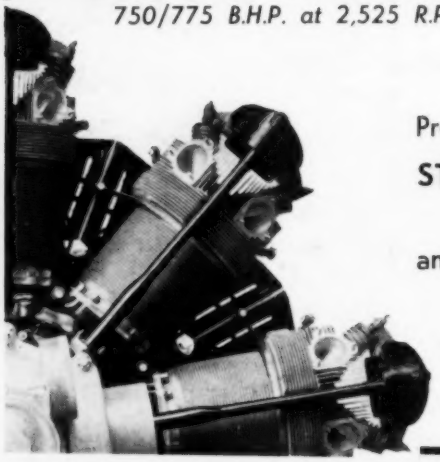

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